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Front cover: *White tiger cubs and mother (Photo: Das)*

Back cover: *Photo: Ghorpade*





*Gharial, Maganadi River, Satkosha Gorge Sanctuary, Orissa, India, following release back to the wild.*

## CROCODILE CONSERVATION IN INDIA

*by N. D. Jayal*

As a result of concern for the future of the Indian Gharial (*Gavialis gangeticus*), the Government of India sought assistance from the United Nations Development Programme in carrying out a status survey. A report of FAO (1974) noted that the gharial was on the verge of extinction, the saltwater crocodile (*Crocodylus porosus*) extremely rare, and the Indian mugger (*Crocodylus palustris*) a depleting species not threatened with extinction in the foreseeable future.

The Government of India accepted the report and sought U.N. assistance in initiating a project for conservation/management work on all three species. The Government of India accepted the suggested procedure of rapid multiplication of the populations by collection of wild laid eggs for captive incubation, raising of the resultant young, and restocking of specially-selected, gazetted, sanctuaries with juveniles of

1.20 m length at which age they are free from predation other than by humans.

An early account of this work in Orissa, the first State to take up the project, is given in FAO (1975). The Government of India accepted from the outset the need to gazette and manage sanctuaries in key areas of gharial habitat or their former habitat. All three areas which had been recommended as gharial sanctuaries in the first report (FAO 1974) were gazetted sanctuaries by 1975 – extremely speedy implementation considering the practical difficulties on the ground.

In the interim the Project has produced about 2000 gharial. Restocking in the wild commenced in 1977 in Orissa where to date, 72 gharial have been returned to the wild. A small batch have also been released in Rajasthan, and in Uttar Pradesh 14 have



been released in Katarniaghat Sanctuary and 15 in the National Chambal Sanctuary. Large-scale restocking will take place this winter when approximately 250, 1.20 m gharial will be released. Some will be put into Satkosia Sanctuary on the River Mahanadi, Orissa, some into Girwa River within Katarniaghat Sanctuary (the Girwa gharial are markedly different from other populations), but the bulk will be released into the Chambal River from where the eggs were collected. All three areas have been declared sanctuaries under the scheme. The last named is the recently declared National Chambal Sanctuary, remarkable for its large size (5400 sq. km. with a river length of approximately 400 km.) and the fact that it is the first truly National Sanctuary in India. It is being funded totally by the Government of India which is coordinating activities of the three States in which this large sanctuary lies (Uttar Pradesh, Madhya Pradesh and Rajasthan). The costs for this one sanctuary during the Sixth Five-Year Plan period are estimated to be Rupees 1.3 Crores (= US \$ 1,625,000).

The project now knows of 190 gharial in the wild in Chambal River, Girwa River (the Uttar Pradesh State Gharial Sanctuary) and Mahanadi (Orissa) alone. Gharial also occur in a number of other States (Rajasthan; apart from Chambal, Bihar, Madhya Pradesh; apart from Chambal, Assam Arunachal Pradesh, etc.) for which we have no reliable estimates.

Protection under the project, quite apart from releases of captive-reared stock, is resulting in the gharial starting to make a come back. By March 1979, there were further releases of about 200 animals back into the wild. The wild population is expected to exceed 1000, two metre plus individuals by early 1981 and can then rapidly be doubled to 2000.

The Project has also carried out a well coordinated programme of research on Indian crocodiles as well as the gharial. The first Ph. D thesis on the gharial has already been submitted and six more research scholars are working on the Project.

The Government of India, FAO and UNDP have throughout laid a stress on training. The Government of India, in 1978, created a Central Government Institute devoted to crocodiles which is receiving technical assistance from FAO/UNDP. The Institute – the Central Crocodile Breeding and Management Training Institute – located at Hyderabad, took in the first batch of trainees representing 10 states of the Federal Union for a nine-month Certificate Course in December 1978. The syllabus covers all aspects of crocodile breeding and management together with sanctuary and wildlife management since protection in the wild of all wildlife, not just crocodiles, in well-managed sanctuaries, is a corner stone of the project rehabilitation programme.

## Saltwater Crocodile

The Bhitarkanika Sanctuary in Orissa, likewise specially gazetted under the project has now, through releases and management, built up its crocodile population to around two hundred. The population will be maintained at this optimum level. In addition, the Government of India project has sub-projects for this species in West Bengal (Sunderbans) where no detailed estimate of the size of the wild population is available, and where first releases of 40 individuals have already taken place; Andhra Pradesh, where the first pilot release took place in March 1978, and hopes to initiate a project shortly in the Union Territory of Andaman and Nicobar Islands.

## Mugger

The Indian marsh crocodile or mugger was never endangered, only depleting. The project has mugger schemes in the States of Orissa, Uttar Pradesh, Gujarat, Tamil Nadu, Andhra Pradesh and Kerala, and it would already be possible to produce several thousand each year were the environment (available habitats) able to absorb this number. So, although the mugger may not be numerous at the present time it is in no way endangered, and never has been, and the project will ensure its successful rehabilitation within the next two to three years.

## Habitats

The available habitat for all three species has become greatly reduced due to land alienation resulting from a wide range of development activities. For instance, taking the case of the saltwater crocodile, it may not be possible to have a wild population of more than two or three thousand. The mugger is extremely adaptable, occurring in a wide range of habitat conditions, from flowing rivers to small tanks. However, five to ten thousand would be a reasonable wild population for the entire country. The important thing for the future is not merely the total number, but to ensure that they are divided between a number of National Parks or sanctuaries in different parts of the country, which has not been possible so far in other cases such as the Great Indian Rhinoceros or the Indian Lion, for example.

The real problems all lie in the future – the need to be able to retain large sanctuary areas free from all types of human interference including pollution – but these are world-wide problems. Pressures will remain inexorably high on India's forests, and hence on sanctuaries, and other forest related problems such as soil conservation. The gharial is as surely threatened when the deep pools it inhabits in flowing rivers become silted up, as when it falls prey to a poacher's gun. Similarly, the saltwater cro-



codile will not be able to survive the total destruction of India's mangrove forests.

Even here the picture is far from bleak. Commercial fishing, a major source of destruction of crocodiles which are caught in nets, both accidentally and as a form of poaching, has been banned in many of the Project sanctuaries including Satkosia Gorge Sanctuary, Mahanadi River, in Orissa, the entire Bhitkar Kanika Saltwater Sanctuary, Orissa and the Girwa River Gharial Sanctuary, Uttar Pradesh. In Orissa, realising the threat to the whole mangrove ecosystem, the Government of Orissa, under the Project, stopped all felling of mangrove trees by the State Forest Department and made alternative arrangements to supply the fuel wood and timber needs of the local population by opening timber depots and bringing in fuel wood from elsewhere. These are major achievements.

In our view, the Government of India Project has been a major success story on the Asian wildlife scene. No country has done more than India to conserve its crocodilian resources and nowhere has the effort met with such marked success. The initiation of the project has coincided with (and perhaps to some extent has also been instrumental in creating) a wave of interest in wildlife and its conservation in India. This is a most heartening development as it is important to broaden the base for wildlife appreciation in the country.

The project has been so successful on the crocodile rearing side that suitable areas set aside as sanctuaries can be rapidly filled up. There will be no ha-

bitat in the wild for most hatchlings of most species from eggs hatched in 1979 and in subsequent years.

The project appreciates the active interest being taken by those involved in enterprises working towards crocodile conservation in India such as the Crocodile Bank which is creating a wider interest in crocodiles in the country. The Crocodile Bank could make a major contribution to crocodile conservation on a world basis by setting up captive breeding groups of the really endangered species – of which there are many – along the lines it has already done so successfully for the Indian mugger. If it can achieve a similar level of success with these endangered species it will provide the rationale for the creation of sanctuaries for endangered species in their natural habitat. Time is running out for a number of crocodilian species. The Crocodile Bank, located in the ideal crocodile environment of South India, could help to ensure their future.

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*A baby gharial emerging from the egg in the first ever captive hatching of the species.*





A large herd of Blackbuck at a habitat (Photo: Sankhala)

## HABITAT PREFERENCES, FEEDING AND SURVIVAL OF THE BLACKBUCK

by Indra Kumar Sharma

The unique antelope, the blackbuck (*Antelope cervicapra*), is fast vanishing to the point of extinction. Formerly, it was found in large numbers in the plains of India, but now it only survives in a few pockets where it enjoys protection, particularly close to *Bishnoies* communities who consider it to be sacred and give it complete protection.

### Methods and Procedures

Habitats of the blackbuck were surveyed in the Jodhpur region of Rajasthan State in India to study the habitat preferences of the blackbuck. Four different typical habitats were selected to study the relationships between availability of flora and their palatability preferences and feeding behaviour, as well as various factors affecting survival chances of the blackbuck. The study was conducted mainly at Gura-Bishnoia area, which abounds in blackbuck and gazelle (*Gazella gazella*), as well as many other desert fauna. Feeding preferences and behaviour were observed directly, analyses of droppings were performed to find the percentage of flora taken by the blackbuck. The study was carried out from January 1975 to June 1978.

### Physical Conditions of Gura-Bishnoia (Jodhpur)

The study area is semi-arid, about fifteen km.

from Jodhpur city. The area is largely sandy scrub-wasteland with a fair number of seasonal agricultural farms where cultivation is largely done in the rainy season (June – October). Average annual rainfall is 370 mm. Maximum temperature in June is 45°C and minimum temperature in January about -2°C.

Major vertebrate fauna are dog (*Canis familiaris*), jackal (*C. aureus*), Desert fox (*Vulpes vulpes*), hedgehog (*Paraechinus micropus*), hare (*Lepus nigricollis*), and Desert cat (*Felis libyca*). Birds found in the area include: peafowl (*Pavo cristatus*), Grey partridge (*Francolinus pondicarianus*), Common babbler (*Turdoides caudatus*), bulbuls (*Pycnonotus cafer* and *P. leucogynus*) and Grey shrike (*Lanius excubator*). Reptiles present include: *Varanus griseus*, *V. bengalensis*, common viper (*Echis carinatus*), among others.

### Habitat Preferences

Large scrub grasslands, close to a tank, river, ravines or canal were found to be the most preferred habitat of the blackbuck, having the highest population density.

The blackbuck only inhabits denser vegetation grassland scrubs and wastelands around perennial agricultural fields; it does not occur in semi-arid wastelands and scrub as the gazelle does. This is because the food requirements of the blackbuck are



much heavier and cannot be satisfied at semi-arid scrublands.

It was noted that as the blackbuck is comparatively more robust and lives in larger herds, the smaller-sized species such the gazelle disappear or become reduced in population at the places which the blackbuck inhabits. This is due to competition among them and the dominance of the blackbuck.

It was observed that the blackbuck does not live far (more than two or three km) from the source of water as it needs to take water more than twice a day. It migrates locally with the change in availability of water and green grasses. Such requisite and local migration was not observed among the gazelle.

Scrub wasteland between perennial agricultural farms is also a preferred habitat of the blackbuck as it can enjoy the availability of green crops from the agricultural farms as supplementary food.

### Herd Sizes and Population Density

The blackbuck is notable in that during the non-mating season a large herd (more than eight does) may be accompanied by more than one buck, the number of bucks in a herd increasing with the number of does. During the rut season, only one male remains with a herd of does, the rest of the bucks having been driven out by the strongest buck of the herd; or bucks may divide a large herd into several small herds.

It was noted that a large herd normally does not grow to contain more than 33 individuals (5 bucks and 28 does). At very favourable areas having enough available water and food, several herds may accumulate close by for food, water and rest, without serious territorial behaviour. This may present a mistaken picture of a large herd of hundreds of bucks and does to an uninformed observer. The assembled herds at such an amiable site later separate and move to their respective home ranges in the afternoon.

The growth of herds with high breeding success (about 60–80%), varies according to how severely the litters are subject to predation by stray dogs and wolves.

It was observed that Blackbuck herds are largely found to have male to female ratios of 3:18, 5:22 and 5:28 during the non-mating season (April–June and December–January). These split off into smaller herds, generally with ratios of 1:8, 1:11 and 1:14, during the rut season. Pure buck herd sizes increase up to 10 and on rare occasions up to 22 have been observed. This happens because mature young bucks of bisexual herds join all male herds.

It was observed that herd sizes frequently changed with the seasons. One, because of the struggle between bucks of the area to share does in the herds, and secondly it changes with the availability of food

in the area. In the rainy season the herd size increases by a union of smaller herds and in the summer (drought) large herds break up into smaller herds and have sufficient food per head and spread wide to decrease the pressure of grazing on the area.

Population densities of the blackbuck were found to range from three to twenty-one per sq. km., depending upon the availability of water and green food.

### Feeding

The blackbuck seems to prefer perennial green grasses e.g. *Dactyloctenium aegypticum*, *Eleusine compressa*, *Cenchrus ciliaris*, *C. setigerus*, *Cynodon dactylon*, *Desmostachya bipinnata* and *Cyperus* spp. which occur in a fair density at habitats of the blackbuck.

Besides grasses the blackbuck takes shoots, sprouts and leaves of *Crotalaria burbhia*, *Convolvus pluricaulis* and *Helitropium strigosum* herbs, *Zizyphus nummularia* and *Prosopis cineraria* shrubs. It takes *Lycium barbaum*, *Maytenus emarginatus*, *Capparis decidua* and *Belantia aegyptica* during the drought season.

The blackbuck is a serious pest to agricultural crops and does heavy damage to Mung (*Phaseolus aureus*), Moth (*P. aconitifolius*), Gaur (*Cyamopsis tetragonoloba*), Chana (*Cicer arietinum*), Mustard (*Brassica campestris*), Wheat (*Triticum* sq.) and Cucumber (*Cucurbita* spp.) crops of agricultural farms close to its haunts. The blackbuck generally invades agricultural farms late at night by jumping over fences which may be up to two meters high.

### Predation

The desert region is relatively free from large predators except stray dogs and, in some places, the wolf. The dog is a serious predator of the blackbuck. Two or more dogs try to encircle and chase a blackbuck, leaving little chance to escape. Occasionally a robust buck succeeds in penetrating a horn into the belly of the attacking dog in self-defence. The wolf hunts the blackbuck in a similar fashion.

The doe delivers her offspring between a thicket of *Zizyphus* or *Capparis* bushes so that the fawn may have a better chance to avoid coming to the notice of predators. The dog robs young blackbuck fawns in a considerable percentage (estimated at about 40 or more depending upon population of stray dogs in the area) at an early age (less than a week), when helpless and weak young fawns are unable to run fast enough to escape. The mother does not dare to oppose the predator. The jackal and the jungle cat also occasionally prey on the blackbuck fawns.



## Poaching

As the blackbuck has been considered a prized game animal it has been completely exterminated by poachers at most of its former habitats. Now it survives only at a few large suitable Bishnoies localities, where it enjoys complete protection against poaching by the Bishnoies people, who provide rigid protection to deer. Bishnoies consider it their sacred religious duty to protect deer (gazelle and blackbuck) at all cost. They stringently take to task the poachers who dare to poach a deer within their localities. Because of this deer poaching is rare in Bishnoies areas.

Occasionally an individual or even a herd of blackbuck strays far away (about 1 or 2 km) from the Bishnoies area, in search of better pasture. Poachers take advantage of this to take the strayed ones. It was also noted that poachers have been known to bribe a shepherd to drive a herd of blackbuck out of the Bishnoies areas, thus allowing the poachers to take the blackbuck or gazelle. Some affluent poachers try to poach late at night at the periphery of Bishnoies localities with a jeep and search-lights and often suc-

ceed in escaping before being caught.

## Conservation of the Blackbuck

Grassland scrubs close to perennial tanks in Bishnoies areas having the blackbuck should be made into reserves for the blackbuck so that they may not starve in the drought season, having tough competition from cattle of nearby villages.

The survival chances of the blackbuck (as well as of the gazelle) are secure enough in Bishnoies areas while the Bishnoies have their deep religious beliefs and sentiments to protect deer, and if these areas are declared reserves they may serve as less expensive and more successful sanctuaries with the volunteer services of Bishnoies.

Perennial tanks or rain pools should be dug or improved at blackbuck habitats as well as more green food (grasses).

Populations of stray dogs should be checked around such reserves regularly. Similarly, overpopulation of the jackal, the wolf and jungle cats should be controlled to prevent any adverse effects of these predators on the blackbuck.



*Villagers feeding a semi-feral Blackbuck doe (Photo: Sankhala)*



## WORLD CONSERVATION STRATEGY

*The following text was excerpted from Robert Wazeka's article "A World Conservation Strategy is*

*Launched", which appeared in UNASYLVA (FAO), Vol. 32, No. 127.*

On March 5, 1980, in the capitals of 30 countries press conferences were held to launch a World Conservation Strategy. It found, in the words of United Nations Secretary General Kurt Waldheim, "an unprecedented degree of agreement on what should be done to ensure the proper management and optimal use of the world's living resources. . ."

The Strategy was in large part the work of the International Union for Conservation of Nature and Natural Resources (IUCN), which had the cooperation and support of the United Nations Environment Programme (UNEP) and the World Wildlife Fund (WWF). Ultimately, more than 450 governments, international agencies, conservation groups and other non-governmental organizations were involved. Consultations were made with more than 700 scientists and development experts from more than 100 countries. The entire process took three years. "The very existence of this strategy", said Russell Train, President of the World Wildlife Fund, "might be viewed as something of a miracle."

### FAO's View

Typical of the response to the Strategy was the Statement made by Edouard Saouma, Director General of FAO: "I need not further elaborate on the timeliness and usefulness for the developing countries of this publication which, in clear terms, relates development to conservation issues for the needs of the present as well future generations. You may therefore rest assured that we will assist in promoting the Strategy and bringing this document to the attention of governments and living resource users. We will also try to ensure that the various principles set out in the document are taken into consideration from the project formulation stage onwards in our own work."

### Objectives and Recommendations

There are three major objectives in the Strategy:

(1) to maintain essential ecological processes and life-support systems such as soil protection and regeneration, nutrient recycling and the cleansing of waters; (2) to preserve genetic diversity among plants, animals and microorganisms; and (3) to ensure the suitable utilisation of species and ecosystems

which support millions of rural communities as well as major industries, particularly regarding forests, grazing lands, fish and wildlife.

Many specifics are spelled out in the Strategy's report. Careful planning for sustained-yield forestry is recommended for both the public and private sectors. Protection programmes for habitats are encouraged, particularly for economically valuable species, endangered and unique species, unique ecosystems and representative samples of ecosystem types. Action on the problem of acid rain is called for. The need for protecting watersheds, wetlands, estuaries and crucial coastal habitats is underscored. The Strategy recommends giving attention to such problems as urban sprawl, overgrazing and "imprudent irrigation." It states that agricultural land must be preserved, particularly in the breadbasket of North America, and that this need should override conflicts with urban, industrial and transportation requirements.

In general, the Strategy gives guidelines which it hopes individual nations will adopt in ways suited to their own particular needs. It outlines concrete kinds of legislation which governments can use as tools or models in conserving their resources. On problems affecting the "global commons" —atmosphere, oceans, Antarctica, fishing rights—it recommends international agreements. For river basin and small seas problems it recommends regional action.

### Development and Conservation

Repeatedly the Strategy report emphasizes the simultaneous need for development and conservation, arguing that development is, in fact, often the best road to conservation. "Too often," the report says, "we assume that people are destroying the environment because they are ignorant, when in fact they have no other choice."

One of the key elements has been that non-governmental conservation organizations have been involved in the Strategy from the beginning. In the past, such groups have often had the chance only to intervene at the last stage of a project to try to stop it, thereby casting themselves as obstacles to development and, in some cases, human welfare. In this case, however, they have had the opportunity to advocate ways of development in which productivity and



economic growth can be reconciled with the need for conservation and preservation.

Ten years ago, said Brian Johnson, of the Institute for Environment and Development, the World Wildlife Fund would not have accepted that in many situations of conflict between using land for agriculture or wildlife, food production would have to come first. Such organizations now accept people-centered development provided that it can be done sustainably.

## Direction

What the World Conservation Strategy actually does is to set a direction and then to propose the means to get the nations of the world headed off in that direction. This "direction" can be broken down into nine major headings:

- 1) To define living resource conservation and to explain its objectives, its contribution to human survival and development and the main impediments to its achievement (sections 1-4).

- 2) To determine the priority requirements for achieving each of the objectives. (sections 5-7).

- 3) To propose national and subnational strategies to meet the priority requirements, describing a framework and principles for those strategies (section 8).

- 4) To recommend anticipatory environmental policies, a cross-sectoral conservation policy and a broader system of national accounting in order to integrate conservation with development at the policy making level (section 9).

- 5) To propose an integrated method of evaluating land and water resources, supplemented by environmental assessments, as a means of improving environmental planning; and to outline a procedure for the rational allocation of land and water uses (section 10).

- 6) To recommend reviews of legislation concerning living resources; to suggest general principles for organization within government; and in particular to propose ways of improving the organisational capacities for soil conservation and for the conservation of marine living resources (section 11).

- 7) To suggest ways of increasing the number of trained personnel; and to propose more management-oriented research and research-oriented management, so that the most urgently needed basic information is generated more quickly (section 12).

- 8) To recommend greater public participation in planning and decision making concerning living resource use; and to propose environmental education programmes and campaigns to build support for conservation (section 13).

- 9) To suggest ways of helping rural communities to conserve their living resources, as the essential

basis of the development they need (section 14).

## Implementation

The framers of the Strategy recognized from the start that the document would be useless, even if it generated widespread support, unless it could be translated into real action. Special attention was therefore given to what kinds of action should be addressed. The report's main author, Robert Allen, of IUCN says that in order to understand the Strategy one must distinguish three different kinds of action: tactical, radical and strategic.

Tactical action, according to Allen, is primarily technical in nature. It includes such measures as ways to check soil erosion, establish national parks and maintain ecosystems. Sections 5-7 of the Strategy do, in fact, deal with just such tactical actions, but in general they are de-emphasized for the reason that many guidelines, manuals, articles and books on "tactical action" already exist.

Radical action attempts to change in a fundamental way certain attributes of human and political behavior. The Strategy specifically rejected the inclusion of radical actions because it felt that any such actions would require strategies of their own as well as a great coordination of will and effort among governments and peoples around the world. Although the report has been criticized in some places for failing to address the population problem and for failing to include or consider multinational corporations, these are both examples of the kind of "radical" actions that were deliberately set aside. Other such radical actions are efforts to reduce excessive consumption among the affluent peoples and to change the economic relationships among developed and developing countries.

Strategic action, examples of which are found in sections 8-14, are broad, but practicable goals and methodologies which are wide enough to permit politically diverse nations to embrace them and specific enough to focus the effort so that they mean something.

Says Allen, "... tactical measures, while essential, have only limited short-term effectiveness. Radical measures, while essential, will take an extremely long time to achieve. Strategic measures, by contrast, are within our grasp and can be of great long-term as well as short-term benefit."

## Obstacles Identified

A key part of the report identifies obstacles to the achievement of its strategic goals. These are: (a) the belief that conservation of living resources addresses only a limited sector of activity rather than being something which cuts across all sectors; (b) the



consequent failure to integrate conservation with development; (c) inadequacies in environmental planning; (d) the lack of a capacity to conserve due to inadequate legislation, weak enforcement and poor organization; (e) the lack of support for conservation due to the lack of awareness of its benefits; and (f) the failure to deliver conservation-based development where it is most needed, notably the rural areas of developing countries.

Many people view conservation as something that can happen only after industrialization, when

institutions and attitudes have developed sufficiently to permit people to think of things other than where their next meal will come from.

The premise of the World Conservation Strategy is that this is not realistic, that, in fact, non-industrialized countries are increasingly concerned about their natural environment and want to both conserve and manage it.

*Robert Wazeka is the correspondent in Europe for a group of North American newspapers.*

## SOME ASPECTS OF BEHAVIOUR AND BREEDING BIOLOGY OF THE INDIAN WILD ELEPHANT

by S. Mohammad Ali

In India the wild elephants occur in broad belts of montane and submontane forests which have territorial and floristic continuity. They are found in the states of north-eastern India, part of West Bengal, Bihar, Uttar Pradesh, Orissa, Tamil Nadu, Karnataka, and Kerala. But for some reason they are absent from Nagaland, Andhra Pradesh, Madhya Pradesh and Maharashtra though these states have forests, especially hill forests, of the kind that elephants favour. The approximate population of wild elephant in India is estimated by the author to be between 9,000 and 10,000 in number.

The population of wild elephant in India consists of a high percentage of non-breeding individuals. They attain maturity at an age ranging from 13 to 20 years, commonly between 17 to 19 years.

The courting and mating is a long drawn process. The female may breed up to the age of 67 years. The gestation period varies from 639 to 684 days depending on the sex of the calves. Generally a single calf is born at a minimum interval of 25 months, to the maximum interval of 103 months, but occasionally twins are also produced. The maximum number of calves that may be expected from a cow elephant is around 15 to 17 during her productive period, if the cow survives over 70 years of age.

The natality rate was observed to be 16.32% at Betla National Park, (Bihar), 25.37% at Bandipur (Karnataka), 29.54% at Nagarhole (Karnataka), 28.40% at Mudumalai (Tamil Nadu) and 23.92% at Periyar (Kerala) wildlife sanctuaries of India.

During the feeding period a herd may subdivide into smaller groups ranging from 3 to 5 individuals, and spend most of their times foraging separately. They maintain frequent contact with other members of the herd at water-holes, rubbing trees and resting places. The female groups are of two types : lactating females with infants and non-lactating females with juveniles. The adult males are primarily solitary. The sex ratio varies from 1 : 3 to 1 : 5 : male to female.

The author made some studies on the occurrence of 'musth' in the wild Indian elephants. It was observed that the stress caused by factors, both external (environmental) and internal (physiological) might initiate the secretion of temporal glands and appearance of 'musth' among the elephant.

*The author is Superintending Zoologist, Zoological Survey of India, Calcutta, and is carrying out a study on the population ecology of the most endangered species of mammals and birds in the arid zone of India.*





## SUCCESSFUL TRANQUILLISATION OF A SUNDARBANS TIGER

*by Kalyan Chakrabarti*

The task of capturing wild animals is not new. Our ancestors and natives world wide survived by trapping animals. The only difference was that their trapping techniques were designed to kill the animals. Present day wildlife managers have modified these trapping techniques so that the animals are caught alive and uninjured. It is necessary that the investigators should be thoroughly conversant with the habits of the wild animal species to be captured. Before taking any action on causing restraint to wild animals several factors should be considered. Which drugs are to be applied and to what extent. What is the condition of the animal — sick or emaciated animals will probably not react to drugs in the same manner as normal individuals of the same species. Such animals may be drug tolerant or sensitive, and they may take twice or only half the normal dose. The reaction cannot be predicted.

As a method it would appear that physical restraint has an edge over drug restraint if the animal can be handled without allowing it to exhaust or injure itself. Physical restraint refers to holding or guiding an animal so that it is in the physical position one desires by means of vocal and/or physical force.

### Dayapur Tiger

A tiger crossed over to the village Dayapur from Pirkhali block of the Sunderbans tiger project area during July 1977 and after killing a cow, took shelter in a hutment. The tiger project official from the nearby office at Sajnakhali immediately communicated details of the incident to Project Headquarters at Gosaba. The whole operation was geared and tranquillising equipment, transfer cage, etc., were made ready by the following day. The darting was made at 17:45 hours with a tranquillising gun. The first dose of tranquilliser (10cc Katamine hydrochloride — Ketaset) was administered exactly at 17:52 hours. Then a second dose of 5cc of the same tranquilliser medicine was administered at 17:59

hours by Injector pistol. The breathing of the tiger was found to be 13 times a minute and the temperature of the tranquillised tiger appeared to be normal by physical touch. Then the tiger was lifted and moved into the cage meant for transport. The first symptom of recovery was observed by the movement of the ear and the facial muscle approximately 3½ hours after the second dose had been administered when the dragging operation was on. The tiger was ultimately transferred to Alipore Zoo, Calcutta for observations and veterinary care. Treatment was rendered to the tranquillised tiger and detailed observations of biological properties of the animal were also kept. This was the first incident of successful tranquillisation of a Sundarbans tiger and ultimate tranlocation to a Zoological Garden.

### Effect and Action of Tranquillisation: Ketamine hydrochloride

Ketaset is a rapid acting anaesthetic producing an anaesthetised state characterised by profound analgesia, normal pharyngeallaryngeal reflexes and skeletal muscle tone, mild cardiac stimulation, and some respiratory depression. The anaesthetised state produced by Ketamine has been termed "dissociative anaesthesia" in that it appears selectively to interrupt the association pathway of the brain before producing somesthetic sensory blockade.

Following administration of recommended doses of Ketaset, blood pressure and heart rate are usually moderately and transiently increased. Respiratory rates on the other hand are usually decreased in cats. A patent airway is ensured by virtue of maintained pharyngeal reflexes, and although some salivation is occasionally noted, the persistence of the swallowing reflex effectively renders this hazardless. By single intramuscular injection in cats, Ketaset has a wide margin of safety.

*The author is Field Director Sundarbans Tiger Reserve.*



## CAPTIVE BREEDING OF THE THAILAND BROW-ANTLERED DEER

(*Cervus eldi siamensis*)

The Wildlife Propagation Centre at Khao Khieo is an important activity of the Wildlife Conservation Division of the Royal Thai Forest Department. The Director of the Division is Mr. Phairot Suvankorn. This note was prepared by Jeffrey Sayer, FAO Advisor to the Division, based on information provided by Jira Jintanugol, Head of the Wildlife Extension Service, who is responsible for the captive breeding programme. The photographs were taken by Suthipong Sonthithai.

All three subspecies of the Brow-antlered or Eld's deer (*Cervus eldi*) are in serious danger of extinction in the wild. The nominate form *C.e. eldi* occurs only in very small numbers in the Keibul Lamjao National Park in Manipur, India. The race from Burma and western Thailand (*C.e. thamin*) is still thought to occur in parts of Burma but there has been no information published about it in recent years. However populations of both these subspecies occur in several Zoos in India, Europe and North America.

The Thailand Brow-antlered deer (*C.e. siamensis*) was previously widespread in grasslands and deciduous forests in Thailand, Cambodia, southern Lao and Vietnam. Overhunting and habitat destruction have resulted in its almost total disappearance and there have been no substantiated records in the

wild for many years. The only animals of this subspecies in captivity are a small group in France which contains only two males. In addition, the Wildlife Conservation Division of the Royal Thai Forest Department has a female which was obtained in 1974 when she was three years old. It has long been the Division's objective to establish a captive herd of these deer and eventually to reintroduce them into some of the National Parks and Sanctuaries in Thailand where they once occurred. It proved impossible however to find a mate for the female and as she grew older, hopes of ever breeding from her began to fade.

News from Paris Zoo was also discouraging; their animals are not breeding well and one adult recently died. In 1978, the Wildlife Conservation Division obtained a male of the closely related *C.e. thamin* from Washington Zoo. The two animals are kept together in a paddock at a Nature Education Centre at Khao Khieo Wildlife Sanctuary in Chonburi Province, 100 km. east of Bangkok.

The *siamensis* female at Khao Khieo mated with the *thamin* male in 1979 but the fawn of that union died shortly after birth. They mated again in 1980 and the head of the Nature Centre, Mr. Phairot Chailertpongsa has been giving them very special care throughout the year. He was rewarded when a healthy male fawn was born on October 22nd. At the time of this writing the fawn is three weeks old







and he and his mother are both doing well.

This success is encouraging but does not solve the problem of preserving the subspecies from extinction. The new fawn is only 50% *siamensis*. However, if the herd can be built up, an attempt will be made to select for *siamensis* characteristics and the possibility always exists that an infusion of new *siamensis* genes will be possible in the future if another animal

can be obtained from the wild in Thailand or from the Paris Zoo collection. The reintroduction of these beautiful deer to the parks and sanctuaries of Thailand would provide added interest for visitors and would fill an ecological niche for a medium-sized grazing animal. It would also provide further example of the Thai government's commitment to conserving the fauna of the Kingdom.

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## STATUS OF PANTHER (*Panthera pardus*) IN GIR SANCTUARY

by Sanat A. Chavan

Gir Santuary in the Katiawar Peninsula of Gujarat, a compact block of forest encompassing 1412.13 Sq.Km., is famous world over for containing the last stand of Asiatic Lions. Besides lions there is also a heavy concentration of Panthers (*Panthera pardus*). However, very little attention has been centred on this versatile carnivore with its magnificent beauty and grace. Gir sanctuary holds a unique position in having the heaviest concentrations of two major carnivores living in harmony with their surroundings, separately. The panther has also perfectly adapted itself to the conditions of life imposed by nature in the Gir ecosystem.

### Description

The panther probably has no equal in its combination of looks and performance. The panther, the "complete athlete" of the animal world, can boast of all round abilities of running, climbing, swimming and jumping. With the aid of its excellent sensitivity panther can walk, jump, swim, climb and pursue prey, even in pitch darkness, with deadly precision.

With some good fortune and lots of patience, I have been able to watch the panthers in Gir Sanctuary scores of times, mostly in the early evening hours, and in a few cases during the hot afternoon



hours. As it pads to and fro along *Acacia* or *Butea* one can fully appreciate the economy and ease of its movements and the superb details of its anatomy.

The long body is supported by fairly short, muscular legs. It has a rounded head and closely positioned eyes, providing perfect binocular vision. Added to this is the ability to dilate and contract the pupils, allowing the panther to adjust smoothly to both the shadows and the glaring light. Padded feet are furnished with curved, strong retractable claws enabling it to climb trees vertically either to hide its food or to chase a monkey. Even the long tail helps in maintaining precise balance when the animal leaps. The panther can merge with its surrounding, be it tall grass or forest under-growth and trees, as quickly as it moves.

### Feeding Habits

Regarding its food, the panther displays an astonishingly varied choice of its prey. It is mainly the size and strength of the predator which decides the nature of its prey. Starting from the smallest prey animal—hare—the panther also preys upon wild boar and full-grown chital. I have seen sambar yearlings attacked by panther, but the panther had to leave it injured, unable to kill it. In Gir, those panthers living close to habitations viz. Sasan, Jamwala, Bhalchel, Visavadar, etc., usually feed on dogs, goats, sheep, young buffalo and carrion. Those whose home ranges are in the heart of the Gir Forest are equally preying on common langurs, peafowl, wild boars, hares, chital yearlings (at times even attempting adult chital kills), sambar fawns, etc. I have come across a few cases, where the panther had killed porcupines for its food (in two of these cases seen by me, the panthers died due to porcupine quills having pierced vital body organs). During the season of sugarcane and ground-nuts, panthers on the fringes of Gir Sanctuary shift their operation to these fields in search of wild boars raiding the crops. Panthers are also known to kill goats and stray dogs around Gir.

The vital issue that confronts us is that the smaller prey species are controlled by larger carnivores in the food chain. But what are the factors which control the larger animals at the end of the food chain? Mainly it is a question of the availability of food supplies. This is the factor governing such a large concentration of panthers in Gir Sanctuary.

To protect his food from other predators, the panther hides his prey under cover. In hiding his prey, the panther shows remarkable ingenuity by even taking his prey high up in the trees.

In one case at Hadmatiya (Gir) a male panther was seen killing a full grown wild boar, in a field and then climbing up a coconut tree with the kill, to hide

it among the leaves.

Panthers are quite often seen at the site of lion kills, after the lion has left.

### Habitat

This versatile animal is adaptable to a wide range of habitats:

- Western Gir, where teak is predominate, forming dry deciduous forest.
- Thorn scrub forest in the western most portion, North West portion and mid Gir.
- Hilly, savannahs in eastern Gir, where Teak (*Tectona grandis*) is replaced by Dhav (*Anogeissus latifolia*). More or less confining itself to the hills in Gir, the panther descends to the flats to hunt its prey.

### Behaviour

Panthers are solitary animals and usually can be seen moving about singly. In general, the only time male and female are seen together is during the mating season. However, I have seen male, female and two 4–5 month old cubs together no less than 3 times. Mating takes place any time during the year. The gestation period is 93 to 103 days, the female giving birth to 2 to 4 cubs in a sheltered rocky hollow in the hills. The male remains with the family for a while, helping in hunting. Panther cubs start killing small prey by the time they are 6–7 months old. At the age of one year they start taking active participation in hunting excursions.

This clearly shows that panther cubs mature and start hunting earlier than lion cubs of the same age.

### Black Panther

Some panthers are completely black, rosette clusters just visible in the coat. Once considered to be a separate species, they are now regarded as one form of the species *Panthera pardus*. The difference between the black panther and spotted panthers is the gene which transmits the coat colour. The last known record of black panther in the Saurashtra region of India is from Girnar forests. Black panther was caught there around 1954.

### Status in Gir Ecosystem

The panther plays a vital role in the ecological equilibrium of the Gir region. The heavy population of common langurs (*Presbytis entellus*) and Peafowl (*Pavo cristatus*) in the Gir Sanctuary is kept under control by the panther.

Because of its great adaptability and different food habits, the large population of panthers has thrived well in the Gir ecosystem. Whereas the lion



preys upon Chital, Sambar, Nilgai and wild boar, the panthers depend upon langurs, peafowl, and wild boar. These divergent food habits help the panthers in Gir, which is predominantly the lion's habitat. The panthers occupy an overlapping home range with the lion's home range.

The panther's high birth rate, its wide range of food, its adaptability to varied living conditions, plus its marvellous ability for concealment have helped it to withstand the human enemy.

### Antagonistic Behaviour

There are few direct confrontations between the lion and the panther in Gir. In a few cases, that I came across, the panther, lifted a young lion cub and was chased and killed by the lioness. However, I have seen more confrontations between the panther and the hyaena over food. Where a pair of hyaenas were present, usually they succeeded in chasing away the panther.

### Conservation and Management

Gir forests are surrounded on all sides by villages, whose livelihood depends upon cultivation and cattle breeding. On many occasions these vil-

lagers have suffered a loss of cattle. Cases of physical injury are negligible. In the past, a heavy toll of panthers was taken by shooting them around the villages or even poisoning them. One essential factor in any wildlife reserve is to win over the surrounding population by tact, rather than force. These tactics have succeeded to a large extent for the protection and conservation of the Panther in Gir.

Whenever there is a complaint of a panther menace in Gir, this information is immediately sent to Sasan (Gir). A party of trackers and wildlife staff, along with a cage, is sent to the spot. After determining the actual location where the panther is hiding, the cage is set up with a live bait for its capture. When the panther has been captured, all surrounding villagers are informed. The captured panther is taken into the heart of Gir Forests and released at a suitable location. My experience has shown that, people often feel relieved that their danger is removed along with saving of the panther, with the result that there have been very few cases of panther killings in recent years.

*The author is Deputy Conservator of Forests, Silviculture Forests Utilization, Rajpipla (Gujarat) India.*



*Panther caught from Gir boundary village, being released in central core forest area in Gir Sanctuary  
(Photo: Sanat Chavan)*



## DISTRIBUTION AND STATUS OF THE SNOW LEOPARD (*Panthera uncia*)

by Leif Blomqvist

*Reprinted with permission from the International Pedigree Book of Snow Leopards, Vol. 1, published by the Helsinki Zoo, Finland, 1978.*

### Systematics

There is some uncertainty as to the systematics of the Snow leopard. Two name combinations exist, namely, *Panthera uncia* and *Uncia uncia*. Those, who consider the first name combination as the correct one, include Lions, Tigers, Jaguars, and Leopard in the subfamily Pantherinae, and also include the Snow leopard among the other Leopards. According to this "school", these cats all have similarities of the skull (1). Those, who prefer the name *Uncia uncia*, are separating the subfamily Pantherinae into two different orders: the Snow leopards as one species and the above mentioned other four as another group (2).

Some also mention that subspecies exist among the Snow leopards (1, 10). For instance, Stroganov points out that the Snow leopard in Central Asia is lighter in colour and has fewer dark spots and rosettes than the other geographic variations, of which the terra typica is Nepal. According to Dang, the western and Central Asian have a longer tail, while the eastern specimens have a somewhat stockier body. However, there are many who do not believe in the existence of any kind of subspecies (11, 12). The Helsinki Zoo has, with the co-operation of some other Zoos and with the aid given by Professor Bjorn Kurten, started a project to investigate the possibility of subspecies among the Snow leopards. Thus, osteological material from museums plus the Snow leopards, kept in captivity in different Zoos, will be used as material for this investigation. As far as is known, at least one Zoo in the U.S.A. has Snow leopards that are smaller than those in most other Zoos. The difficulty of this project lies in the fact that sufficient data on the place of capture does not often exist, and that few museums possess any osteological material concerning the Snow leopards. In spite of this, it seems quite probable that subspecies exist, especially, when knowing the large distribution area of the Snow leopard.

### General Characteristics

The colour of the Snow leopard is yellowish grey, and the solid black spots on the head become open rings and rosettes on the dorsal side of the body

and the tail. The ventral<sup>o</sup> parts are lighter in colour. Further, the ears and the front of the head are more rounded than in the Common leopard, *Panthera pardus*, and the tip of the tail of the Snow leopard is always black on the dorsal side, while the ventral side is almost white. Furthermore, the head of the Snow leopard is not spotty as that of the Common leopard. The most characteristic feature is the long, thick tail, almost 1/3 of the length of the body. When the temperature is very low, the Snow leopard rolls the tail around the body to keep itself warm.

The male Snow leopard weighs about 40 kg, while the female is somewhat lighter. Although, the Snow leopard is closely related to the Common leopard, the anatomy of the skull differs significantly. The nasal cavities, for instance, are much larger in the Snow leopard, an adaption to its environment. These large cavities make it easier for the Snow leopard to utilize the oxygen in the thin air where it lives. The legs are rather short and the broad paws prevent it from sinking in the snow. This is another adaptation to the environment of the Snow leopard, as well as the thick, fluffy fur. The pupilla is round and small, sight and hearing are well developed.

### Status, Distribution and Population

As the Snow leopard lives in such inaccessible areas i.e., in the mountains of Central Asia, it is very difficult to estimate the size of the wild-living population. The normal techniques used for other species, do not work in the Himalayas. The mountains in this part of the world are that extensive that no brief survey can be made on the wildlife in all the valleys and along all the ridges. As the Snow leopard lives above the tree-line, the population has always been smaller than that of the Common leopard which, for example in Nepal, is distributed from the tree-line down to the sea-level. This is not possible for the Snow leopard, which has adapted itself to a cold climate.

The Snow leopard population is distributed over parts of the USSR, Mongolia, China, Nepal, Bhutan, India, Pakistan, and Afghanistan. Thus, although found over a large longitudinal and latitudinal territory, it is obvious that it is restricted within this range to the cold regions and, generally to the glaciers of permanent snow (1).

### The Soviet Union

In this country, the Snow leopard is to be



found in an area, extending from south Siberia to Tadzhikistan and Kazakhstan (10, 11, 13, 14). According to Stroganov and Novikov, it exists in Siberia only in the Altai – and Sayans mountains and very seldom in Tuvinia. It is most common in the mountain valleys of Tadzhikistan; in Gissar, Zeravshan and in the mountains of Darvaz, in the western parts of the Pamir mountain range, in Tien Shan, Chatkal, Talass, Alatau, in Kirgisia, Trans-Ili, Dzungarian-Alatau, in Saur and in Tarbagatai.

According to the *Red Data Book*, the number of Snow leopards in the Soviet Union continually decreases, but it is still numerous in Tadzhikistan and is not in danger of extermination in Kazakhstan. Most of the wild-caught Snow leopards in the Zoos of the world have been captured in Kirgisia. Two new reserves, both about 300,000 ha, have recently been established in Kirgisia and in Turkmenistan. As recently as in 1961–1964, 24–60 Snow leopard were shot annually (13), but today, the Snow leopard is totally protected in the Soviet Union, and only a certain quota can be caught for zoo-purposes. This quota is, however, very small, and in 1976 only six animals were wild-caught in the whole world. In 1977, only one animal was wild-caught (Kirgisia) (16).

#### Mongolia

The *Red Data Book* estimates the number of free-living Snow leopards in Mongolia to be less than 300 animals. An isolated population is supposed to exist in the area of Upsgal. However, our information from this country is not very complete.

#### China

In China, the Snow leopards dwell in the mountains around Sinkiang, in the northern parts of Tien Shan, in Pamir, in Astin Tagh. The mountain range extends from the Tibetan plateau to the north-eastern parts of the province of Chinghai and Kansu. Furthermore, Schaller has reported that the Snow leopard is to be found also in the western parts of Szechavan (27). Most of the Snow leopards, which have been wild-caught in China for zoo-purpose, have been captured in the province of Chinghai (18). Unfortunately, we have no reliable data on the size of the Snow leopard population in China.

#### Nepal

As Rodney Jackson has just arrived from Nepal, after spending one year (1976–1977) in this country studying its fauna, we have more information regarding this country than from most of the other Snow leopard distribution areas, though the Snow leopard situation is no more encouraging in Nepal than in any

other "Snow leopard country". Like anywhere else, it is very difficult to estimate the size of the Snow leopard population in Nepal. With reference to the Jackson report (19), the number of the Snow leopards in Nepal is certainly less than 300, most probably less than 120. Jackson has reached this conclusion by estimating the average number to one Snow leopard/110 km<sup>2</sup>. In the Namlang valley, Schaller has counted 3–5 animals within an area of 250–350 km<sup>2</sup>, i.e. one animal/70 km<sup>2</sup>. Referring to the Jackson report, most of the Snow leopards in Nepal live in the districts of Mugu and Dolpo where, by his estimation, about 60 Snow leopards exist. From the valley of Namlang, also investigated by Schaller (20), Jackson is sure that the Snow leopard will disappear in 2–4 years if the conditions continue as before. The only places in Nepal, where the Snow leopard could survive, are some areas in the Dolpo and Mugu districts (21). In the Dolpo district, an area of about 240 km<sup>2</sup> has been proposed as a sanctuary (the Shey area) but, so far, no decision has yet been made by the Nepalese government. In his recommendation to the Nepalese government (19), Jackson points out the importance of the establishment of the Shey reserve and, also, that another sanctuary should be established in the Mugu district. Both these areas have more prey species, making survival possible, than any other area in Nepal. Furthermore, these are the only areas in this country where the density of the human population is low. Although it has been reported that every mountain valley in the Himalayas has its own pair of Snow leopards (1), Jackson reports that even the two reserves in this region (the Langtang Reserve and the Mount Everest Reserve, each about 800 km<sup>2</sup> large) no longer have had any evidence of Snow leopards living within their areas. Jackson, also, proposes that the Snow leopards should be re-introduced into these areas.

Jackson points out that Schaller has reported from Pakistan and Afghanistan that despite complete legal protection by the Nepalese government, the Snow leopard is still being hunted in this country. Although the restrictions of the fur trade have led to a fall in the price of the Snow leopard pelt from \$ 50 to \$ 10 in 3–4 years, this has not been sufficient, and the animals are still being hunted, not on account of the price of the pelt, but because of the old hunting traditions of the mountain inhabitants. The people of Nepal still hunt the Snow leopard and by very effective method: poisoned bamboo spears are angled in the ground along a favoured trail.

#### India

In India, the Snow leopard is to be found only in the northern parts of the country i.e., in Kashmir





*Snow leopards (Photo: Helsinki Zoo)*

where there is a sanctuary, the Dachigam Sanctuary, 170 km<sup>2</sup> large. The presence of the Snow leopard in Bhutan has also been reported (22).

#### **Pakistan**

In Pakistan, the Snow leopard is reported to exist in Chitral, in Gilgit, and Baltistan, as well as, in the northern parts of Azad Kashmir (13, 14, 17, 20, 23, 24, 25, 26).

As only a small part of Pakistan lies within the Himalayan mountain ridge, Schaller estimates that only about 100 Snow leopards are living in this country (24). The Red Data Book gives us, however, an estimate of 250 Snow leopards for Pakistan. Schaller points out that, although it is forbidden to sell the pelts, the mere knowledge that a Snow leopard is living in a mountain valley, is such a strong temptation to the natives, that the animal will have very few chances to survive. According to professor Schaller, there is no mountain valley in Pakistan where these animals could live in peace.

Schaller, who has visited Pakistan many times during the 1970's, says that the Snow leopard is a big rarity, even in the area of Chitral. In 1970, Schaller found tracks of one animal and he also saw a female plus cub in the neighbourhood of the city of Chitral. During the winter of 1972–1973, at least six Snow leopards were shot in this area, and during the following winter, Schaller estimated that only 4–5

animals were still living in this area which is about 1,900 km<sup>2</sup> large. Because of the lack of prey species, only a few or no females give birth, as their nutritional condition constitutes a great danger. Still, the situation is much better in Pakistan than in most of the other Himalayan countries, mostly because of the fact that the prey have not disappeared in the same degree from this country as from other countries, and because the density of the human population is not as high as in the other countries.

The Snow leopard was not granted game status before 1972. It was hunted without licence and limits everywhere in Pakistan. The only place where it had territorial protection before 1972 was in the Sanctuary of Chitral Gol. According to Schaller (24) Ian Grimwood reports that in 1969–1971 a furrier in Peshawar usually had 15–20 whole pelts in his store, and that he had admitted that his annual turnover might have been as high as 50 Snow leopard pelts. As this man was not the only furrier in this country, it is understandable how great the danger of depletion of the Snow leopard must have been before 1972. Now, the Snow leopard is, however, legally protected in Pakistan but, also has been observed in other countries, this is not enough to give the protection the Snow leopard urgently needs to survive.

#### **Afghanistan**

The distribution area of the Snow leopards in



Afghanistan is restricted to the area around Hindu Kush. The number of Snow leopards, living in Afghanistan, is not known, but it must be rather small, as only part of this country lies within the Asian mountain ridge.

In 1978, a female cub was illegally wild-caught and smuggled into Europe. This cub, born in May 1977, is now in a Zoo in GFR.

## Ecology

Generally, the Snow leopard is encountered above the timberline where it inhabits rocky wildernesses, snow fields, glaciers, and meadows as far as the belt of juniper and spruce forests, rhododendron and other bush vegetation (14). Seasonal migrations occur from higher to lower zones. In the winter months, the Snow leopards descend from 4,000 m or even from higher altitudes to an altitude of 2,000 m and, in the spring, when the snow starts to thaw, they ascend to higher zones in the mountains. Their migrations depend on climatic conditions, as well as, on the movements of the ungulate herds which are their main prey (1, 10, 11). It has also been suspected that the Snow leopard would be incapable of living in a true forest habitat (23) and, this again, would be a control of how low the Snow leopard descend in the winter. In some areas the Snow leopard descends rather low. In the Aktau mountains (Dzungarian Alatau, USSR), the Snow leopard is common at altitudes as low as 600–700 m and in Talass Alatau (also in USSR), the Snow leopard has been encountered at an altitude of 1,200 m (11). The vegetation in these areas does not include forests, but consists mainly of bush vegetation. However, the Snow leopards are mostly to be found at 2,000–3,000 m in the winter and at 4,000 m or more in the summer (2). In the Chitral district in Pakistan, cultivation extends to an altitude of more than 3,300 m and even above that altitude. Domestic goats graze almost to the limit of the vegetation at an altitude of over 4,500 m (17). In summer, the cats can only live on the steepest and most remote terrains, according to Schaller. Therefore, each winter, less and less of the Snow leopards' prey and, of course, the Snow leopards themselves, all having been driven down by the snow to within the reach of the villagers' guns, survive until the time of their return to the summer ranges.

## The Prey Species of the Snow Leopard

The main prey of the Snow leopard is Bharal (*Pseudonis nayaur*), Markhor (*Capra falconeri* sp.), Takin (*Budorcas taxicolor*), Serow (*Capricornis sumatraensis*), and Thar (*Hemitragus jemlahicus* sp.) (1, 10, 11, 23). They also feed on Musk deer (*Moschus moschiferus*), which are found in the birch and

willow zone, above the forest edge. Farther east, where no Markhors exist, the Bharal replace them in the diet of the Snow leopards (24). Further, the Snow leopard preys on Woolly hares (*Oistulus lepus*), *Oistulus roylei*, and even on Snow cocks (1). At low altitudes, in the Aktau mountains, the Snow leopard has been observed to prey on Persian gazelles (*Gazella subgutturosa* sp.), and in Trans-Ili Alatau on wild Boars (*Sus scrofa*) (11). Other small animals in the diet of the Snow leopards include Marmots (*Marmota* sp.) and Pikas (*Ochtonidae*) (14). However, at least in Pakistan, Schaller mentions that the Snow leopards are only able to survive to some degree by preying on the domestic goat (17). From droppings found by Schaller, 50% consisted of domestic goat and sheep and 31% of Markhors. Also Dang mentions (1) that he had observed a lot of droppings, containing domestic sheep and goats. Of the 34 prey species, investigated by Dang, the majority of the prey had been killed by a bite in the neck or by the breaking of the spine. Novikov (11) mentions that the Snow leopard is mainly caught by trapping.

It has been noted that the Snow leopard prefers to kill male ungulates (1). This might depend on the fact that the males are easier to kill because they are easier to throw off their balance on account of their bigger horns (according to Dang). In addition, the females pay more attention to the surroundings than the males (1).

The Snow leopard is a nocturnal animal that lies in rocky lairs by day and is active mainly during the night (11). In spite of this, according to Dang, all the killed ungulates he found, were killed in the early morning. In the Helsinki Zoo, the Snow leopards have been most active in the late evenings and early mornings (personal observation). In the Sanctuary of Nanda Devi, Dang observed a Snow leopard in the middle of the day, and according to him, the animal becomes less shy in areas where it can live undisturbed by man.

## Social Behaviour

The social behaviour of the Snow leopard seems to be the same as described by Schaller (27) of the tiger: essentially solitary but not unsociable. According to Dang, pairs of Snow leopards have been seen hunting together. Generally, Bharals are being chased from one part of a valley to another where the other leopard is waiting for the frightened herd. Dang also mentions pairs of Snow leopards eating together. Also, Petzsch describes the Snow leopards as living in pairs (6). However, it is worth noting that Dang never has been able to decide whether the pair comprised of two adults or a female plus her cub. The cubs are usually born in May–June (16) and

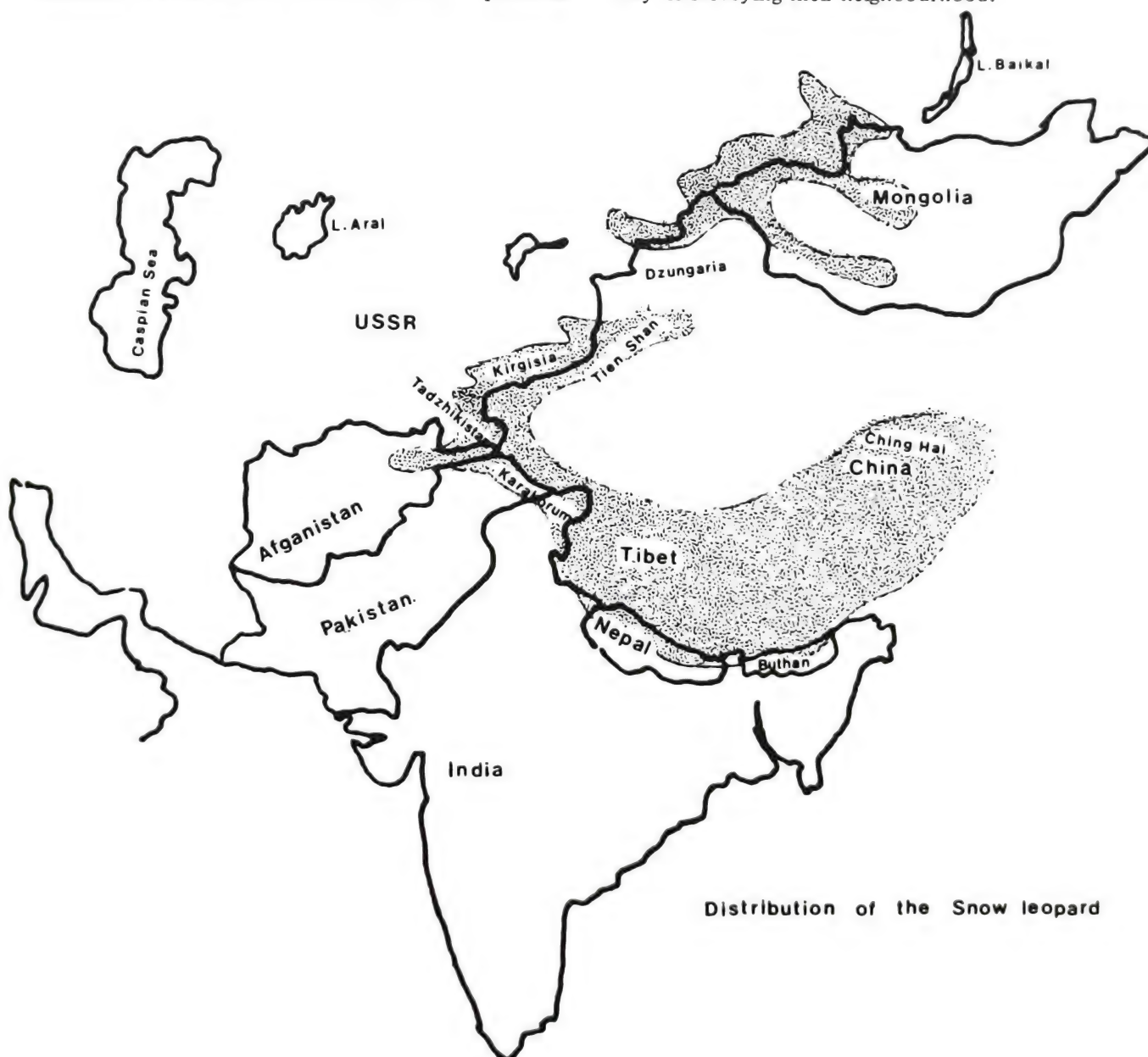


begin to follow their mother in July–August. They then accompany the mother during the following winter (11). At that time of the year, it is very difficult to decide whether it is a question of a subadult cub or an adult animal. Dang reports 16 observations of Snow leopards and in 12 cases, the observations have concerned solitary animals. Also Schaller has been able to find solitary tracks, and when tracks of several animals have been observed, they have always been those of a mother plus cubs (17). Grzimek gives us the same information about two or more Snow leopards being seen together (2). In some Zoos, both parents have successfully reared their young ones (Alberta Game Farm, Edmonton in 1964 – personal communication by Al Oeming, in Howletts Zoo, Bekebourne, England in 1977 – personal communication by John Aspinall and in Woodland Park, Seattle, USA, in 1977 – personal

communication by Helen Freeman).

According to Dang (1), the litter mostly comprises of 2–3 cubs and the same litter size has been reported by Blomqvist from the Zoos of the world (16). In the wilds, the pre- and postnatal mortality must be very high among the cubs, generally caused by the lack of food.

Very little is known about the living areas of Snow leopards. They do not stay too long within the same area, unless they have cubs. It is known, however, that they return to their regular trails and ranges and that they have a fixed sleeping and resting quarter (1). Their dens have been described by Dang, as well as by Schaller. Thick layers of hair and residua of feathers, bones and skins have often been found around their lairs. The dens are their surroundings. In Zoos, the Snow leopards prefer shelves on which they lie surveying their neighbourhood.



Distribution of the Snow leopard



## Future

Blomqvist has shown (15) that, during the last few years, the ratio between the wild-caught and zoo-born animals has increased in the favor of the zoo-born animals. At the same time, the number of Snow leopards, caught in wilds, has continually decreased (15). Whether this depends on the fact that the wild-living population has decreased or not, is difficult to say but as mentioned above, this may be assumed. We have, however, to remember that the Snow leopard has not been legally protected before the 1960's. Nowadays, it is very difficult to obtain a licence to capture an animal from the wilds. The material we have in different Zoos today is quite sufficient. By increasing the co-operation between the Zoos, which during the last years have succeeded in breeding these cats, even better results can be obtained. The first step in this direction has also been taken. In 1976, the Snow leopards in captivity, got a studbook of their own, and today all Snow leopards are registered. This is very important, as we only have 169 Snow leopards in captivity today (on the 31st of December 1977), and everything should be done to avoid inbreeding. This is only feasible if we know the exact genetical background of each animal. In March 1978, the First International Snow leopard Conference was arranged by the Helsinki Zoo.

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## THE IMPACT OF BUDDHISM ON THE CONSERVATION OF FLORA AND FAUNA IN ANCIENT SRI LANKA

by Anslem de Silva

*"Just as with her own life A mother shields from hurt her own, her only child-let all embracing thoughts for all that lives be thine".  
Gauthama Buddha.*

### Introduction

Sri Lanka has a unique flora and fauna, with many endemic forms. Of these some are extinct, a few others are on the verge of extinction. But there is a wealth of evidence to show that conservation measures (protection of flora and fauna) have been taken from the 3rd century BC. (the first ordinance in recent times was enforced in 1885). This influence stemmed mainly from religious (mainly Buddhist) and cultural (Sinhalese) beliefs prevalent in the island.

The Author's premise is that Buddhism above all had the largest single impact on the conservation of the flora and fauna in Sri Lanka. The paper reviews the stand point of Buddhist doctrine in relation to conservation of flora and fauna and the impact of this on the ruling monarchy, and the latter's adherence to and interpretation of such doctrine.

### Place of flora and fauna in Buddhism

One of the fundamentals of Buddhist Teaching is the abstinence from the destruction of life. In the three means of discipline – *pancha sila* (five precepts); *ata sila* (eight precepts) and *dasa sila* (ten precepts), the first precept is that "I take the precept to abstain from killing". Even the first vow when ordaining a monk (according to Theravada Buddhism) is "I abstain from destroying life". It is however, in its doctrine of rebirth and in the reverence of special trees that one encounters the most direct influence of Buddhist thought on conservation of flora and fauna.

### Rebirth

According to the Buddhist doctrine of rebirth a human-being upon dying can be reborn as an animal or an animal upon dying can be reborn as a human being (Gunaratne 1971). In fact the *Jataka* (birth) stories tell us that Gauthama Buddha had been born in this world 449 times either in human or animal form before he attained Buddha hood (enlightenment). Most of these tales show the gratitude of animals. One could interpret the *Jataka* stories as folktales but the primary function now is to teach moral lessons by allegory. Even today many a Buddhist will not kill certain animals, especially the cobra as it is

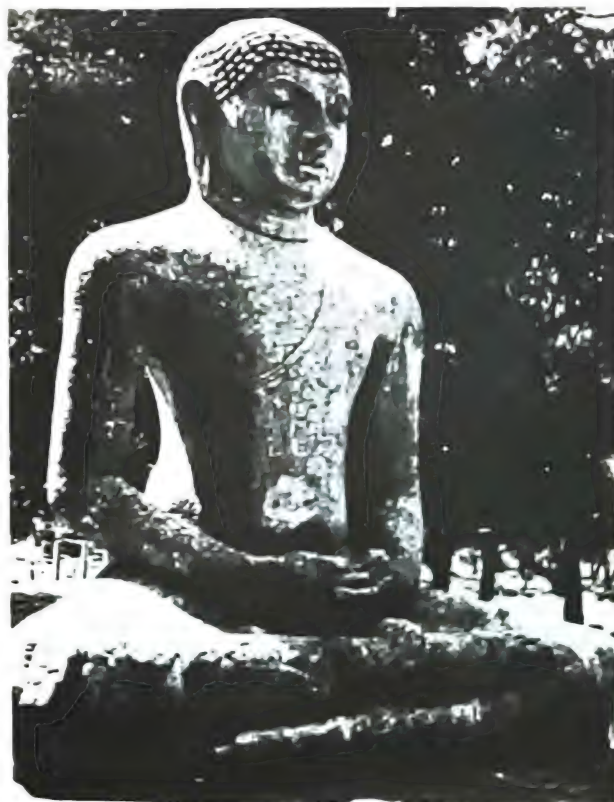
believed to be a reincarnation of departed family members. Also on *poya* (Buddhist sabbath) days many a farmer does not till or plough his fields lest he destroy fossorial creatures. In fact some of Buddha's teachings specifically illustrate *metta* or loving-kindness. Once Buddha saw how animals were killed as offerings to gods. He spoke then, thus,

*"Of life, which all can take but none can give life which all creatures love and strive to keep wonderful, dear, and pleasant into each, even to the meanest . . . . ."*

### Reverence of trees

*"The forest is a peculiar organism of unlimited kindness and benevolence that makes no demands for sustenance and extends generously the products of its life activity, it affords protection to all beings, offering shade even to the axeman who destroys it"*  
Gauthama Buddha.

Buddhist literary records mention 21 species of trees under which 25 Buddhas attained enlightenment. It is highly possible that these were venerated and protected from destruction (It was believed that if a



(Photo: Mahawatte, Courtesy of Archaeological Commissioner)





*Naga-raja Guard Stone (Photo: de Silva, Courtesy Archaeological Commissioner)*

man destroys a *Bo tree* (*Ficus religiosa* L.), there is no penance to expiate such a sin in his whole cycle of existence). At present however, in Sri Lanka only a few trees (*Ficus religiosa*, Nuga – *Ficus benghalensis* L., Sal – *Vateria copallifera* (Retz) Alston, Na – *Mesua ferrea* L.) receive such respect. Of these, the bo tree is the most venerated and respected. It is the most sacred tree in the Buddhist world (de Silva, 1975). According to the Mahavansa a sapling from the Bo tree under which Gauthama Buddha attained enlightenment was sent to Sri Lanka by Emperor Asoka of India to King D. Tissa (250-210 BC). This was planted in Anuradhapura. Since then it has continued to receive royal patronage. This tree is ranked as the world's oldest historical tree.

### Art and Architecture

Zoomorphic paintings and sculpture are profusely depicted in Buddhist art and architecture. Of these animals, the cobra (*Naja naja*) above all other animal forms, has occupied the most prominent place in Sinhala art (de Silva-1972, 1973). Stone carvings of the cobra are found near religious buildings, palaces and water tanks, the three important sites in urban development of the ancient Sinhalese (de Silva 1973). The evidence suggests that it was after the introduction of Buddhism that the golden age of cobra sculpture commenced in Sri Lanka (de Silva

1973). This symbolic message of the depiction of the cobra as guardian is yet believed by many-and hence they do not kill or harm cobras.

The other animals that are depicted are the elephant, lion, bull, goose and horse. Besides the symbolic significance of these animal sculptures, there was no doubt a direct impact on the viewer to respect and have regard for, such animals. As Story (1964) records "There is in Buddhism a greater sense of kinship with the animal world, a more intimate feeling of community with all that lives, than is found in most other religious thoughts".

### Benevolence of the Kings

The recorded history of Sri Lanka begins about the 6th century BC, with the settlement in this island of a people named Sihala (the modern Sinhalese) (Paranavithana 1961). Buddhism was introduced to the Island in 250 BC, during the reign of King Devanampiya Tissa (250-210 BC). Since then the monarchs (except a few) and the Sinhalese people have been Buddhist. There are records of the virtuous deeds done by some of these kings in the Mahavansa, Rajawaliya, and other ancient records.

The following is a resume in chronological order, of the steps taken to protect, conserve or propagate the flora and fauna by the ancient monarchy.

#### Mutasiva (301-250 BC)

This king established perhaps one of the earliest botanical parks, the Mahameghavana garden, on record. It is obvious that steps would have been taken to protect it.

#### Devanampiya Tissa (250-210 BC)

As stated earlier in this paper, during the reign of this king a sapling from the sacred Bo tree under which Gauthama Buddha attained enlightenment was brought to Sri Lanka. It is recorded that saplings from this Tree were planted in many parts of the island (the most recent being planted by the President of Sri Lanka, His Excellency J.R.Jayawardena on 10th February 1979 at Peradeniya).

#### Elara (205-161 BC)

Elara was a Chola invader who ruled Sri Lanka for 44 years. The mahavansa records how Elara even severed his son's head as the son had unintentionally killed a calf by driving his cart over its neck. **Mahadathika Mahanaga (9-21 AC)**

Rajawaliya records that Mahanaga established parks at every 4 gaw (16 miles) on the four sides of the city. He also planted gardens of various trees. **Ada-gamunu (22-31 AC)**

Son of Mahanaga, after ascending the throne proclaimed by the beat of drums through out Lanka that no living being should be destroyed.



### **Buddhadasa (340-368 AC)**

The Mahawansa tells us that Buddhadasa lived a 'Holy-life and had pity for all beings as a father'. Further, it is stated that he appointed veterinarians to attend on elephants and horses, and the king himself cured a sick cobra.

### **Upatissa I (368-410 AC)**

This king was the eldest son and successor to Buddhadasa. His benevolence was extended to even the insects. He used a broom made of peacock feathers to sweep away ants and other insects so that it would not hurt them. Upatissa I was in the habit of feeding squirrels with his own food and set up feeding places for them.

### **Kassapa I (477-495 AC)**

Established gardens in the city and mango groves over the island at a *yojuna* distance from each other.

### **Silakala (522-535 AC)**

Silakala, following the footsteps of Adagamunu (22-31 AC) decreed throughout the island preservation of life for all creatures.

### **Aggabodhi V (718-724 AC)**

The chronicle states thus of Aggabodhi's concern of Fauna, 'To all creatures he gave the nourishment by which each of them live, and whatever makes them happy with that he blessed them'.

### **Mahinda II (777-797 AC)**

The Mahavansa tells us that Mahinda II provided cattle with young corn, and he set apart thousand fields for this purpose.

### **Sena I (833-853 AC)**

This king followed the good traditions laid down by his predecessors. He considered all creatures as his children. Further it is stated that he performed pious actions unheard of towards fishes, four-footed beasts, and the birds; he fulfilled every duty.

### **Kassapa IV (898-914 AC)**

To all creatures on land and water this monarch gave security. His general, Sena Ilanga, performed many meritorious works, one of them being setting free captive quadrupeds.

### **Mahinda IV (956-972 AC)**

The Mahavansa states 'to monkeys and bears, and deer and dogs, did this benevolent man cause rice and cakes to be given'. There is more direct evidence of benevolence towards animals in his Vevelketiya slab inscription, one of the most important epigraphical documents yet discovered. Lines 25-31 states: those who have slaughtered buffaloes, oxen and goats shall be punished with death. Should the cattle be stolen but not slaughtered, after due determination thereof, each offender shall be branded under the armpit....., those who have defaced brand-marks (on cattle) shall be made to stand on red-hot iron sandles".



*Moonstone (Courtesy Archaeological Commissioner)*

### **Vijayabahu (1055-1110 AC)**

Showed great compassion towards crows, dogs and other animals and gave them food.

### **Parakkramabahu I (1153-1186 AC)**

Acknowledged as one of the great rulers of Sri Lanka. Of his meritorious works the chronicle states where, when and by whom was such exceeding great mercy even to animals seen or heard! Further, the same Parakkramabahu ordered that freedom from fear should be given on the four holy days of every month to the beasts and the fish that moved in land and water, and this command he extended to all tanks and other places throughout the island.

### **Nissankamalla (1187-1196 AC)**

We find in this king's inscriptions at Polonnaruwa 'He gave security to all animals in tanks in the three kingdoms. And he ordered that they should not be killed'. In another inscription we find 'ordering by beat of drum that no animals should be killed within a radius of seven *gaw* from the city of Anuradhapura, he gave security to animals. He gave security also to fish in the twelve great tanks, and bestowing on Kamabodin gold and cloth and whatever other kind of wealth they wished, he commanded them not to catch birds and so gave security to birds'.



## Conclusion

As discussed in this paper, the main influence on the conservation and propagation of the flora and fauna in Sri Lanka from ancient times was Buddhism and the Sinhala culture. If not for some of these early measures, by now a vast majority of our national wealth would have been depleted. Only some of these beliefs and traditions are practised in the 20th century. Some typical examples are the reverence, veneration and protection of the Bo Tree, the avoidance of harming cobras and the avoidance of cultivation on *poya* (Buddhist sabbath) days.

Extensive and irreplaceable destruction of montane virgin rain forests and low land forests were carried out in recent times (mid 19th century to present day) for coffee and tea plantations. This not only affected the endemic flora, (there are over 3000 flowering plant species belonging to 1294 Genera and 192 families. Of these about 830 plant species belonging to 342 genera and 94 families are endemic to Sri Lanka (Sultanbawa 1973). Most of the endemic flora is distributed chiefly in the wet, South-West and central montane region), and fauna which abounds the virgin rain forests but also disturbed the traditional Sinhala village, which according to Hettiarachchy



Fresco- Animals paying homage to footprint of the Buddha (photo, Mahawatte, Courtesy of Archaeological Commission)

(1978) abounded in that area. The paddy fields, the residence, the highlands and forests. These forests had been protected for more than 2000 years by the monarchy of the country, even up to the time of Knox (1681) and Davy (1821) as both authors record the abundance of forests 'which none may tell'. However, a good portion of these forests are now cleared. For instance Cramer (1976) records the colossal loss of our forests, 30, 770 acres of forest in the wet zone and 99, 790 acres in the dry zone during a 12 year period, from 1961 to 1972. Government records (Department of Census and Statistics, 1978) show the rapid dwindling of state forests (loss of 2,354,000 acres in 3 years 1978 to 1979). A recent study (de Silva 1978) revealed that about 60% of streams in a particular district which fed the tributaries of the main river had gone dry.

Of the fauna, the elephant (Goonaratne 1978) and some endemic reptiles (de Silva 1979) are fighting against annual decimation and eventual extinction. Although the elephant was captured from ancient times (3rd century BC) by the monarchy for work war and pagents, none were killed or hunted for sport. But during the last two centuries some 'sportsmen' have slaughtered many hundreds of elephants. In more recent times (1952-1956), Goonaratne (1978) records the killing of 400 elephants in these 5 years. Where reptiles are concerned, many hundreds are smuggled out of the country by "tourists". Recent field observations done on the *Cophotis ceylanica*, *Ceratoophora*, *Lyriocephalus*, *Testudo elegans* and certain species of snake populations, showed a marked decrease. No period of Sri Lanka's history has witnessed such rapid destruction and diminution of her flora and fauna as the present. Many of these have already crossed the 'red line' of extinction. However, it is not too late, at least to save the endangered species, if "effective" steps on conservation are taken IMMEDIATELY.

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## TRANSLOCATION PROJECT FOR THE INDIAN RHINO

According to a report received by the World Wildlife Fund—India, from the Central Crocodile Breeding and Management Training Institute (C.C.B.M.T.I.), trial capture of rhinos and their translocation was carried out in January–February 1980 in Assam — at Kurva near Gauhati and at Kaziranga National Park.

The project of capture and translocation — developed in accordance with the decision of the Wildlife Status Evaluation Committee of the Government of India — was undertaken by FAO personnel: Dr. J.B. Sale, an expert in Wildlife Management from the C.C.B.M.T.I. (also an FAO project) and Dr. M.H. Woodford, Consulting Wildlife Veterinarian with the cooperation of the Assam Forest Department.

Five animals were successfully immobilized and transferred to 'holding' accommodation. Elephants — which were used for locating suitable rhinos — proved to be very useful 'vehicles' for this purpose, particularly in the thick jungles. 'Darting' was also done from elephant-back and the drug immobilization technique proved most satisfactory. Immobilized rhinos were lifted on to a sledge and transported on this to a crate or directly to a stockade. The animals were revived either in the crate or in the stockade by an injection of the antidote and, in all cases, they responded rapidly, showing no signs of damage as a result of immobilization or handling. Two of the rhinos were transferred to holding pens at Gauhati Zoo.

During the second phase of the project, the captured animals will be released into protected areas of suitable rhino habitat. The ultimate aim, however,

is to establish several new populations of Indian rhinoceros which is beginning to show signs of overpopulation in some places in Assam.

The Indian One-horned Rhino is listed in Schedule I of the Wild Life (Protection) Act, 1972. Its numbers had been declining due to habitat destruction and illegal poaching — till effective conservation and anti-poaching protective measures provided at the Kaziranga National Park by the Government of Assam and World Wildlife Fund helped to improve its status greatly, over the past five years.

*from World Wildlife Fund India News Release*





## THE STATUS OF THE ENDEMIC LIZARDS, GENUS: *CERATOPHORA*, IN SRI LANKA

by F. Ranil Senanayake

The mountains of Sri Lanka contain a very unusual fauna. They seem to have been isolated from the mainland of India long enough to have produced endemic genera, and in some cases endemic sub-families. The present study was undertaken to determine the status and ecology of the endemic lizard genus *Ceratophora*.

The genus *Ceratophora* is comprised of three species of agamic lizards, all confined to the island of Sri Lanka. They are unusual in appearance by virtue of possessing a prominent rostral appendage. This appendage has earned them the common names of 'Horned' or 'Leaf-nosed' lizards. Early zoologists suggested that this appendage was used to facilitate the discovery of food (Kelaart, 1819). However, the data emerging from this study suggest that the appendage is a secondary sexual character, being more evident in adult males. The use of the appendage in camouflage and crypsis has also been demonstrated (Senanayake 1979).

The most abundant species of the genus is the Rhino Horned Lizard *Ceratophora stoddartii*. So named because the males possess a smooth, conical rostral appendage reminiscent of the horn of a Rhinoceros. This 'horn' is present in females too, but to a much lesser degree. In 42% of the females studied (N = 323) the rostral appendage was vestigial or absent. The rest had a rostral appendage with a mean that was 60% smaller than the mean for adult males.

The colour of the rostral appendage, as well as the colour of the whole animal is changeable. On cloudy, overcast or rainy days the lizards take on drab brown or grey ground colour, often shaded with darker tones. These colours agree with the generally dark colours of the forest in dim light and provide a great degree of crypsis. When the weather becomes sunny and the forest takes on a bright appearance the lizards respond by attaining their 'bright camouflage'. The males in particular become a bright moss green on the sides with an orange bar on the neck region. The ventral part of the head and the horn becomes a brilliant, reflective white. Because of its usual habit of climbing up the trunks of forest trees, this colour scheme confers the appearance of a freshly broken, lichen covered twig. These animals seem to depend so completely on the camouflage for defence that they will not attempt to move away when approached and will remain immobile until touched.

The Rhino Horned lizard is the only species of

the genus that will tolerate urbanization. Large numbers were once found in the gardens and parks of the township of Nuwara Eliya. However, the recent clearing of the montane forests that once surrounded this town have brought about ecological changes that have contributed to a dramatic decline in the urban populations of this lizard. The most noteworthy ecological changes are the rapid dessication of the Nuwara Eliya valley, the immigration of the bird *Centropus sinensis parroti* and the immigration of the agamid lizard *Calotes versicolor*. The bird is a very efficient predator on the slow moving Rhino Horned lizard, while the lizard *C. versicolor* is a superior competitor as well as being a predator on the juvenile Rhino Horned lizards. Thus, it seems unrealistic at present to consider any area other than the montane forests a suitable habitat for these lizards.

*Ceratophora tennentii* is commonly known as the leaf nosed lizard. It possesses a more oval, compressed and scaly rostral appendage than the preceding species. The sexual dimorphism in the size of the appendage is not so evident in this species. In colour, the leaf Nosed lizard is extremely polymorphic. Taylor (1953). He notes that in the collection of the American Museum of Natural History, every specimen demonstrates a different colour pattern. To date, five basic colour patterns have been recorded, each pattern corresponding to a ground colour of either grey, green, blue green, brown or reddish brown.

In habit it is quite similar to the Rhino Horned lizard. It ascends the trunks of trees up to a height of about 3 - 4 feet where it looks for insects, worms etc. Movement readily activates it, causing it to jump down from the tree to capture its prey. This habit may have contributed to its rapid demise in cardamom plantations where it was once very common. The use of pesticides in the cardamom plantations has been increasing over the last five years. The habit of being readily activated by moving prey may have led to the indirect poisoning of the lizards feeding on dying insects etc. There does exist a strong correlation between the incidence of pesticide use and the demise of known populations of this lizard. Thus their populations, in the only habitat that they occupy, other than montane forest, may soon disappear.

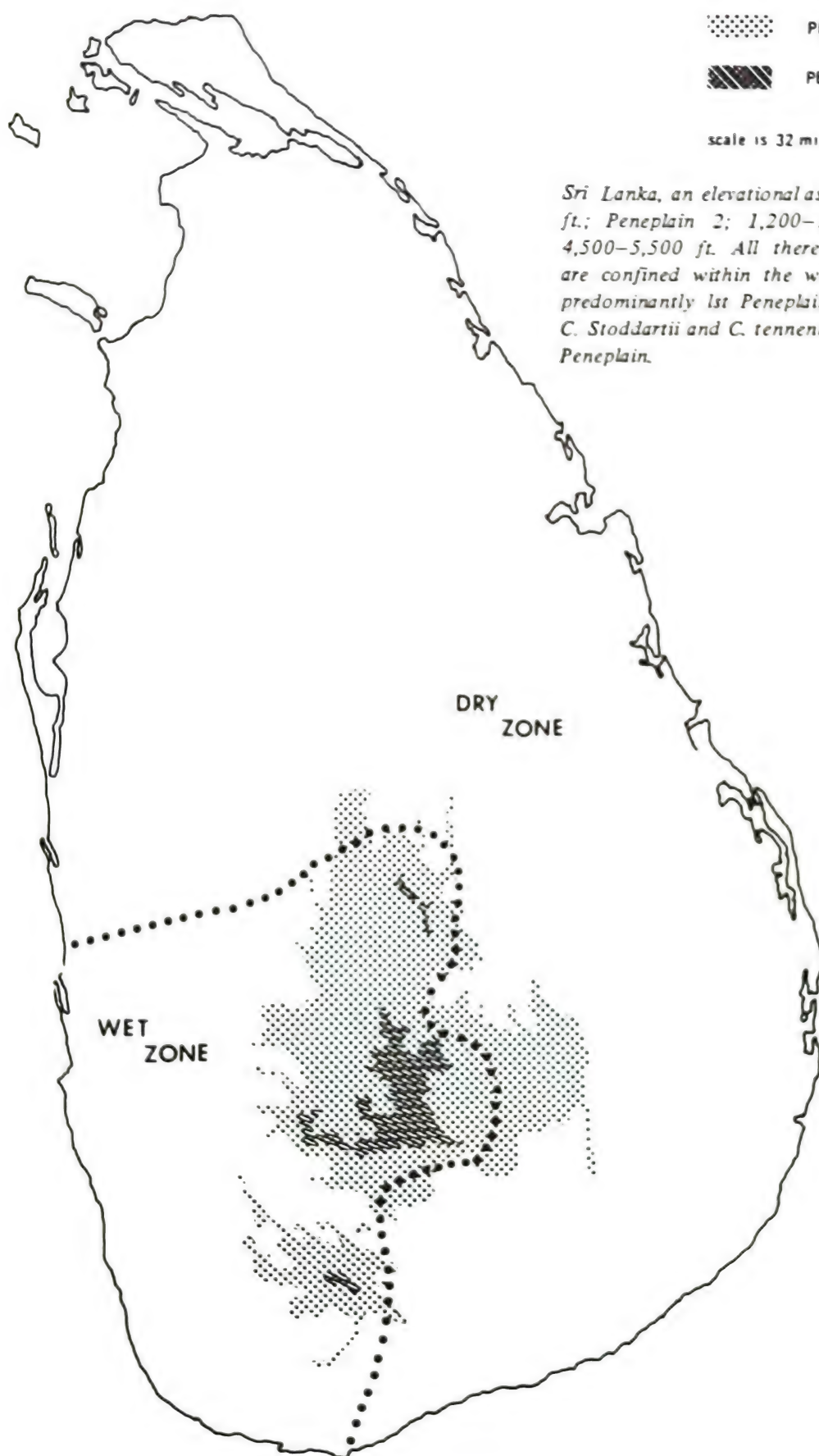
The entire population of this lizard is confined to the montane forests and cardamom plantations of the Knuckles range of mountains. The fact that no wildlife refuge exists in this area and that only around





scale is 32 miles per inch

*Sri Lanka, an elevational aspect, Peneplain 1: 0-500 ft.; Peneplain 2; 1,200-1,800 ft.; Peneplain 3; 4,500-5,500 ft. All there species of Ceratophora are confined within the wet zone, C. aspera being predominantly 1st Peneplain; C. Stoddartii and C. tennentii are confined to the 3rd Peneplain.*





8000 acres of forest enjoy any status of government control, when coupled with the fact that an ever increasing acreage of montane forest goes into cardamom cultivation every year makes the future of this species bleak.

*Ceratophora aspera* is the smallest member of the genus having a snout to tail tip length of about 110 mm. It has an extremely rugose cylindrical rostral appendage hence the common name of Rough Nose Horned Lizard. This species demonstrates the greatest sexual dimorphism in size of the rostral appendage. The females always having a rostral appendage at least 50% smaller than the males. The colour of the body is brown or brownish grey with a darker vertebral stripe. The male has an orange throat and orange upper lip.

This lizard is terrestrial and does not climb trees in the manner of the other species of the genus. It occurs in the lowlands or midhills in primary rain forests, usually on the ground among dead leaves. Deraniyagala (1953) has recorded this species as being common in groves of the palm *Oncosperma fasciculatum*.

The Rough Nose Horned lizard also depends on crypsis and camouflage for its defence. When disturbed it falls or leaps to a side and remains motionless, in the manner of a disturbed twig or leaf. This species is extremely intolerant of habitat disruption and disappears when primary rain forest cover is lost. The creation of the 25,000 acre Sinharaja reserve comprised of primary rain forest has confirmed the conservation of this species.

The extreme dependency of these species on very specialized habitat demonstrates clearly the need for habitat conservation. While such species may be

recognized as endangered, an act of legislation protecting the species alone will not guarantee survival. In all cases where a specialized species is recognized as being endangered, its habitat should also be identified and corresponding legislation be passed protecting that habitat.

In the case of *Ceratophora*, two species can be considered relatively 'safe' as reasonable tracts of their habitat have been preserved. These two species are *Ceratophora stoddertii* which has over 25,000 acres of habitat under protection and *C. aspera* which has over 25,000 acres of habitat under protection. *C. tennentii* however has no area of habitat under absolute protection and is susceptible to being exterminated if the habitat is lost.

After the habitat of species is conserved as a permanent reserve, the next major pressure on that species is mainly through commerce. At present, the legislation dealing with trade in endangered species is reasonably well developed. Thus legislation affording habitat protection with the conferment of endangered or threatened status on species, may prove to be a useful tool in wildlife conservation.

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*Ceratophora stoddertii* (Photo: Senanayake)



## KALAKAD: A SANCTUARY FOR THE LION-TAILED MONKEY

by K. Viswanathan

*Macaca silenus* (Linnaeus), more popularly known as the Lion-tailed monkey, is a rare member of the family of monkeys. It is endemic to India and at present is confined to only a few pockets of ever-green forest of the Western Ghats in Tamilnadu and Kerala.

Sugiyama (1968) observed that the present distribution range and wild population of the Lion-tailed macaque is very small and that their extermination is likely unless strong measures for their preservation are taken. Kurup, after exhaustive studies over a period of years regarding the status of this animal, has estimated the total lion tail population to be about 55 troops with a total of approximately 825 animals.

Thus it becomes evident that this shy and reclusive animal has the most restricted distribution as compared to any other Indian primate. And with its habitat – the ever-green forests of the Western Ghats-shrinking day by day this animal is considered as one of the many endangered animals of the Indian sub-continent. Accordingly it is given full and absolute protection under the Wild Life (Protection) Act, 1972. Under provisions of this Act, even possession of a Lion-tailed monkey without a 'Certificate of Ownership' issued by the Chief Wild Life Warden is an offence. The killing and sale of the animal constitute offences punishable by a mandatory imprisonment for a term which shall not be less than six months but may extend to six years and also with a fine which shall not be less than five hundred rupees. Its export in any form has been completely banned. Because of its endangered status, it has also been included in Appendix I of the convention on International Trade in Endangered Species of Wild Fauna and Flora.

The main reason for the animal losing much of its foothold is the shrinking of its habitat due to extensive destruction and conversion of the forests into coffee, tea, turmeric and cardamom plantations. Such inroads often led to fresh habitations by humans in areas hitherto undisturbed. However the main cause for the animal becoming endangered, is the systematic poaching of this animal for the alleged aphrodisiac property of its flesh. Young ones are also captured for sale as live specimens, very often killing their mothers in the process.

In pursuance of the provisions of the Wild Life (protection) Act, Government of Tamil Nadu set up the Kalakad Wild Life Sanctuary in March 1976. This sanctuary contains many other animals besides Lion-tail, but to date, this is the only sanctuary for Lion-tails in India, and possibly, the world.

The sanctuary extends over an area of 22.3 square kilometres and lies between latitudes 8 25' N and 8 35' N and longitudes 77 25' E and 77 35' E. It is situated in the south western part of Tirunelveli district and is about 50 kilometres from Tirunelveli town. The nearest airport is Trivandrum, 140 kilometres away, while Madurai airport is 210 kilometres away. The nearest railhead is Cheranmahadevi, 25 kilometres away. The best method of approach is by road from Tirunelveli.

Before being constituted into a sanctuary, the Kalakad forests had a chequered history. It is gratifying to note that even in the early 1890's, exploitation of timber was done only by Selection felling system, thus causing the least disturbance to the evergreen composition of the forest. Not more than 1-3 trees per acre were allowed to be cut. In later years, however, some felling series were prescribed for fuel. This system continued up to 1973, when all the felling series except two were stopped. Even these two series have been put to an end since 1976, at which time the area was converted into a sanctuary. From April 1977, the sanctuary has been under the charge of a separate Wild Life Warden stationed at Tirunelveli. And now a special management plan which will cover a period of ten years from April 1978, has been prepared. Of the many objectives desired and listed, the following two require special mention:

- i) to conserve the highly endangered Lion-tailed macaque together with its habitat and to maintain a viable population of liontails for scientific, aesthetic, cultural and ecological values;
- ii) to improve the habitat by eliminating the disturbances caused by forest operations, cardamom and tea cultivations and acquiring the private enclaves within the sanctuary.

A variety of forest types can be found in the sanctuary. At least six different forest types (Champion and Seth) are recognised. They range from the



West Coast Tropical Evergreen Forest to Ochlandra Reed Brakes. Consequently a vast concourse of flora is found in any given area offering a field day to botanists and others interested in flora study. To name a few, the following species occur commonly: *Palaquium ellipticum*, *Durio rosayraona*, *Mesua ferrya*, *Dysoxylum malabaricum*, *Elaeodendron glaucum*, *Elaeocarpus tuberculatus*, *Calophyllum elatum*, *Artocarpus heterophyllus*, *Cinnamomum zeylanicum*, *Mimusops elengi*, *Myristica laurifolia*, *Stereospermum personatum*, *Kingiodendron pinnatum*, *Terminalia paniculata*, *Sterculia villosa* etc. It is interesting to note that *Decussocarpus wallichianus* (*Podocarpus latifolia*), the only indigenous broad leaved conifer occurring south of the Himalayas also occurs here. Besides this some other rare plants like *Bentickia codapanna*, *Apama barberi*, *Dioscorea wightii*, *Entada pursaetha*, *Gnetum ula* and *Piper barberi* are also present. A variety of *Pteridophytes* and a few species of Orchids are also known to occur in the sanctuary.

In addition to the Lion-tails the sanctuary contains endangered animals such as Tiger, Panther, Nilgiri langur, Nilgiri Tahr, Indian Elephant and the Indian Pangolin. About four kinds of deer, the Gaur, the Sloth bear, and the hyaena are some of the other animals found. The sanctuary is also quite rich in avifauna. Crocodiles are conspicuous by their absence in spite of the presence of some perennial streams.

The sanctuary is expected to be ideal for the Lion-tails mainly because of its terrain, which is very rugged and undulating. It is mostly inaccessible with steep precipitous slopes and deep valleys. Except for three roads covering a length of about 75 kilometres and a bridle path running from east to west almost dividing the sanctuary into two halves, there are no other roads worth the name. A trek along this bridle path is highly rewarding.

A forest lodge is located at Sengaltheri, right within the sanctuary. It takes about two hours drive by jeep to reach this haven of peace and tranquillity from Tirunelveli Town.

The present protective staff at the sanctuary is wholly inadequate and unequipped with modern gadgets to face the threat of seasoned poachers. The staff require firearms as well as powerful binoculars not only for spotting Lion-tails, but also the poachers. A walkie-talkie is a must in such a vast area with difficult terrain. Some more subordinate staff should be appointed, especially fire fighting staff, as the sanctuary is prone to fire hazards.

Necessary measures to improve the status of this sanctuary into a National Park must be taken to ensure the safety of these beautiful animals which are maintaining a tenuous foothold in scattered forest pockets of these Western Ghats.



## WHY HAVE *PROSOPIS JULIFLORA* IN THE INDIAN WILD ASS HABITAT?

by G. M. Oza, M.Sc., Ph.D., F.L.S.

Only about 3 decades ago, the estimated numbers of the Indian Wild Ass — (*Equus hemionus khur*) were put at around 5000. In recent years, the deserts of the Rann of Kutch have witnessed a decline in the population of this endangered species and it is now estimated to number around 700 only.

The genus *Prosopis* has 40 warm American species. Theodore Cooke (1903) in his *Bombay Flora* did not list *Prosopis juliflora* (Sw.) DC.

One of the reasons for the endangered status of the Indian Wild Ass or Ghor-Khar is the introduction of *Prosopis juliflora* into its habitat and consequently it is deteriorating. The insect-infested pods from the plant may also pose a danger of spreading disease in the animals.

In fact, the floristic elements in the tropical thorn forest/scrub are sufficient in wild, for the survival of the population in the range of its habitat. But the preservation of the indigenous flora is neglected. The general composition of the flora in the area under observation is:

*Acacia leucophlaea*, *A. nilotica*, *A. senegal*,



*Achyranthes aspera*, *Aerva lanata*, *Alangium salvifolium*, *Alhagi camelorum*, *Anogeissus pendula*, *Balanites aegyptiaca*, *Barleria prionitis*, *Bauhinia racemosa*, *Boerhaavia diffusa*, *Bombax ceiba*, *Bruguiera gymnorhiza*, *Calotropis procera*, *Capparis decidua*, *Cassia auriculata*, *Ceriops candolleana*, *Cleome gynandra*, *Convolvulus microphyllus*, *Cordia dichotoma*, *C. rothii*, *Dactyloctenium aegyptium*, *Euphorbia nerifolia*, *Indigofera cordifolia*, *I. enneaphylla*, *I. linifolia*, *I. trigonellodes*, *Lannea coromandelica*, *Lawsonia inermis*, *Lepidagathis trinervis*, *Maytenus senegalensis*, *Pennisetum cenchroides*, *Pupalia lappacea*, *Salicornia brachiata*, *Salvadora oleoides*, *S. persica*, *Solanum nigrum*, *Sterculia urens*, *Suaeda fruticosa*, *Tamarix spec.*, *Tribulus terrestris*, *Zizyphus mauritiana* and *Z. nummularia*.

The jeopardising effect of the unwanted introduction of the tropical American *Prosopis juliflora*—the 'mezquit' tree is that it has extended right into the Velavadar (Blackbuck) National Park in Saurashtra

and is proving detrimental to wildlife. Its invasion needs control.

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## EURASIAN BEAR GROUP

The Eurasian Bear Group (EBG), an affiliate group of BBA, will participate in the 16–20 August 1982 International Theriological Congress (ITC), University of Helsinki, Finland. The bear conference will be titled the *Euro-Asian Bear Symposium*, and will be published as part of the proceedings of ITC. Publication costs are covered by ITC.

The Conference will include a business meeting of the Eurasian Bear Group, but other BBA members or affiliate groups are free to participate in the Symposium. There may be associated workshops.

The official language will be English. Your intent to participate, the proposed title of your paper, and your address are due 31 December 1980; abstracts are due 31 March 1982. Papers can be on research or management subjects, but should be current (topical). Travel and accommodation costs will not be covered. For further information and the submission of title, contact the Conveners:

Dr. Charles Jonkel, Chairman, IUCN Bear Group, School of Forestry, University of

Montana,  
Missoula, MT 59812 USA

Dr. Hans Roth, n.238, i-38010 Spormaggiore (TN), Italy

## FORMATION OF IUCN AD HOC BEAR GROUP

A new IUCN ad hoc bear group was formed recently at the Fifth International Bear Conference on Research and Management held in Madison, Wisconsin, U.S.A. The group is interested in research and management of the four species of East Asian bears. There are very few members at this time who reside in East Asia and they would like to attract more members from the Asia-Pacific Region.

Interested parties can obtain information about the group and membership by writing to Audrey Goldsmith, Secretary EABG, Department of Forestry and Conservation, University of California – Berkeley, Berkeley, CA 94700, U.S.A.



# PUBLICATIONS

## ENVIRONMENTAL MONITORING AND ASSESSMENT

(Spring 1981). Edited by G. Bruce Wiersma and Andrew I. Sors. D. Reidel Publishing Company, Dordrecht-Holland.

Environmental Monitoring and Assessment is a new international journal intended to bring together and present advances in the monitoring of the environment and the assessment of environmental data. The journal emphasizes the use of scientific principles in the design, development and implementation of monitoring systems at the local, regional and global scale. The scope of the journal includes the use of monitoring in the estimation and evaluation of pollution risks to man and the environment. Particular attention is devoted to methods and procedures for the synthesis of monitoring with ecological, toxicological, epidemiological and with pre-market screening.

Examples of specific areas of interest to the journal are:

- the design and development of single media and multimedia monitoring systems, sampling techniques, optimization of monitoring networks, data handling, quality and assurance procedures, operational costs.
- the scientific basis for monitoring, the use of biological indicators, dynamic and commitment models, pollution indices, etc.
- exposure assessment: the development of monitoring systems which allow direct or indirect estimates of pollutant exposure to critical receptors.
- ecological monitoring of populations and ecosystems for example in biosphere reserves, use of microcosms, etc.
- methods and procedures of risk estimation, including assessment of pollution sources, pathways, exposures, trends in time and space, anticipatory systems, evaluation of environmental quality and of management practice, and methods of assessing pollution impact on the natural environment.

Papers accepted for publication will be research and development orientated. Data intensive papers showing the results of monitoring projects will also be considered for publication, particularly if they illustrate principles of monitoring systems design. Occasional review papers and book reviews will be published.

## Audience

The journal will be of interest to the producers and users of monitoring information. These people include staff of regulatory enforcement agencies as well as research corporations, planners, engineers and technicians, and research workers in environmental processes.

## Subscription Information

1981, volume 1 (four issues). D. Reidel Publishing Co. P.O. Box 17,3300 AA Dordrecht, Holland and 160 Old Derby St., Hingham, MA 02043, U.S.A.

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## MY PICTURE BOOK OF INDIAN WILD ANIMALS

1980. Edited by Meera Holla et al. Thomson Press (India) Ltd., Children's Books Division, New Delhi. Two volumes.

Introducing children to the wonders and beauties of nature and wildlife is one of the best ways to ensure the wise management and utilization of the environment in the future.

Thomson Press (India) Ltd. has just published a beautifully photographed two volume set entitled *My Picture Book of Indian Wild Animals*. Geared for the 5-8 year old age group, it contains a short, easily read description for each animal presented, accompanied by color photographs contributed by wildlife photographers and imaginative illustrations by Pinaki Dasgupta.

Each volume portrays 25 wild animals, some of which are rarely seen in the wild or in game sanctuaries, including tiger, bear, pangolin, rhinoceros and many others. Some educational exercises are suggested at the end of each volume to acquaint the young readers with the habitats and status of the animals presented.

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## NEW RED DATA BOOKS

The four loose-leaf Volumes of the Red Data Book and the Plant Red Data Book are available direct from IUCN, 1196, Gland, Switzerland. New



editions have been issued for freshwater fish (Volume 4) and birds (Volume 2), and new and revised sheets for mammals (Volume 1) and amphibians and reptiles (Volume 3).

Information is assembled in the form of short reports under a series of uniform headings (e.g. Status and Summary; Distribution; Population; Habitat and Ecology; Threats to survival; Conservation measures taken; Conservation measures proposed; Remarks; Reference). The object is to draw universal attention to the dangers facing threatened species, and to provide fundamental background data, as a basis on which to develop conservation or rehabilitation programmes. In addition, by showing at a glance what is known and what still needs to be discovered, it is hoped that the publication of these Volumes will stimulate interest in filling the gaps.

Data for each taxon are printed on coloured sheets. Thus the status of each taxon is readily identifiable; endangered-red sheets; vulnerable-amber sheets; rare-white sheets; out of danger-green sheets; indeterminate-grey sheets.

#### *Volume 1 – Mammalia*

The completely revised edition of the Red Data Book, Volume 1-Mammalia, was compiled by Harry A. Goodwin and Colin W. Holloway of the Secretariat of IUCN, with the advice and guidance of the Survival Service Commission, and issued in 1972.

New and revised sheets for this volume have been issued in 1973, 1974 and 1976. The fourth 'service' of new and revised sheets, issued in 1979, was compiled by Jane Thornback. The total number of taxa covered is 321.

#### *Volume 2 – Aves*

The completely revised (second) edition of the Red Data Book, Volume 2 – Aves, is now available. Part 1, issued in 1978, covered 199 bird taxa. Part 2 issued in late 1979, covers 238 additional taxa and revised data for one taxon included in Part 1.

The new edition has been prepared by Warren B. King on behalf of the International Council for Bird Preservation (ICBP) and the Survival Service Commission of IUCN. Dr King has drawn on the expertise of hundreds of ornithologists throughout the world, including ICBP's National Sections and Working Groups, and many governments and private conservation organizations have cooperated in its compilation.

#### *Volume 3 – Amphibia and Reptilia*

The completely revised edition of the Red Data Book, Volume 3 – Amphibia and Reptilia, was comp-

iled by Rene E. Honegger and published in September 1975. New and revised sheets for this volume, compiled in 1978 and 1979, were issued in 1979.

This volume covers amphibians and reptiles that are threatened throughout their range. It does not deal with taxa that may be in a threatened category within the boundaries of one nation but are relatively abundant elsewhere. The total number of taxa covered is 168.

#### *Volume 4 – Pisces*

The first version of Volume 4 was compiled by Robert Rush Miller and issued in 1969. The completely revised edition, compiled in 1977 by the same compiler, contains data sheets for 194 taxa.

#### *Plant Red Data Book*

The Plant Red Data Book was published last December and was compiled by Gren Lucas and Hugh Syngé of IUCN's Threatened Plants Committee, Kew. It gives details of 250 taxa from 89 countries.

## AN INTERNATIONAL CONFERENCE ON MARINE PARKS AND RESERVES

1976. *Papers and Proceedings of an International Conference Held at Tokyo, Japan, 12-14 May 1975. Published by IUCN. \$10.50. 131 pp. ISBN 2-88032-029-1.*

Provides a basic introduction to critical marine habitats and the planning and management of marine parks and reserves, including interpretation and environmental education in marine parks. Progress in the creation of marine parks and reserves is reviewed, and there is a special report on marine park systems in the Pacific region.

## PLANNING FOR MAN AND NATURE IN NATIONAL PARKS: RECONCILING PERPETUATION AND USE

1973. By Richard R. Foster. Published by IUCN. 84 pp., 5 photos, 10 illus. \$8.50. ISBN 2-88032-035-6.

A guide for students, scientists and administrators to national park planning. Shows how the national park can fit in with the planning and management of the region of which it is a part; and introduces the reader to planning for multi-use.



